

HEALTH SERVICES RESEARCH

Results of the 2015 Scoliosis Research Society Survey on Single *Versus* Dual Attending Surgeon Approach for Adult Spinal Deformity Surgery

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Study Design. An electronic survey administered to Scoliosis Research Society (SRS) membership.

Objective. To characterize surgeon practices and views regarding the use of two attending surgeons for adult spinal deformity (ASD) surgery.

Summary of Background Data. The use of two experienced attending surgeons can decrease the operative time, estimated blood loss, and perioperative complication rates. However, the current practice patterns for the use of two attending surgeons remains unknown.

Methods. An electronic, 27-question survey regarding single/dual attending surgeons was administered to the SRS membership. Determinants included: surgeon/practice demographics, assistant type/level of training, and questions regarding use of two attending surgeons. Overall reporting and comparisons between groups

were made: US *versus* international, academic *versus* private practice, and experience <15 years *versus* >15 years.

Results. A total of 199 surgeons responded from 27 different countries. Overall and between the groups, the respondents significantly reported believing that two attending spine surgeons improves safety, decreases complications, and improves outcomes ($P < 0.01$). Approximately, 67.3% reported using a second attending $\leq 25\%$ of the time (33.2% do not), and 24.1% use one $\geq 51\%$ of the time (similar between groups); 51.1% that have a second attending feel it's limited by reimbursement and access concerns and 71.9% have difficulty getting the second attending reimbursed. 72.3% use a second attending for ALL of the following reasons (no difference between groups): "it's safer/reduces complications," "it decreases operative time," "it decreases blood loss," "it results in improved outcomes," "it's less work and stress for me." If reimbursement was equal/assured for a second attending, 67.5% would use one "more often" or "always."

Conclusion. The respondents feel that having a second attending surgeon improves patient care, however most do not use one often. Reasons include reimbursement/access concerns and the majority would use one if reimbursement was equal and assured. Based on the current literature and these results, there is a need for working with third party payers to improve dual surgeon reimbursement rates in complex cases.

Key words: adult spinal deformity, complications, dual attending spine surgeon, insurance, policy, reimbursement, Scoliosis Research Society, single attending, spine surgery, surgery, survey.

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Adult spinal deformity (ASD) surgery has repeatedly demonstrated significant improvements in pain, function, and health-related quality of life (HRQOL).^{1–13} However, these procedures are technically challenging with a reported high complication rates.^{14–18} These rates increase for patients of older age^{16,19–21} and

those undergoing three-column osteotomies.^{22–26} As with all surgical interventions, there is a strong drive to improve patient safety with one such recent approach involving the use of two attending surgeons.

This approach has been reported previously for other areas of surgery including esophagectomy, mastectomies, and bilateral anterior cruciate ligament reconstruction.^{27–30} Recently this method has expanded to the realm of spine surgery, specifically for both adolescent idiopathic scoliosis^{31,32} and adult spinal deformity patients.^{33,34} Ames *et al*³³ found that two attending surgeons resulted in decreased operative time, estimated blood loss, 30-day major complication rate, and 30-day unplanned surgery. Sethi *et al*³⁴ also found that the dual surgeon approach (combined with a live multidisciplinary complex spine conference and an intraoperative coagulopathy protocol) demonstrated a significant reduction in perioperative complication rates.

Although these select centers have shown positive results with the use of two attending surgeons, there is currently no study investigating surgeons' practices and views regarding this approach. Understanding surgeons' current practice and views may allow for better education, can aid in reimbursement for third party payers, and contribute to future investigative work in this area for spine surgery. Therefore, the goal of the current study was to characterize surgeon practices and views regarding the use of two attending surgeons through a survey of a large international group of spinal deformity surgeons in the Scoliosis Research Society (SRS).

METHODS

An electronic, 27-question survey (Tables 1–4) regarding the use of a single or two attending surgeons during ASD correction was administered to the SRS membership by the Adult Deformity Committee. Determinants included the

surgeons' type and country of practice, Orthopedic or Neurosurgery training, level of current training, the number of years in practice, percentage of practice involving pediatrics and adults, the number of 3-column osteotomies performed each year, and a number of questions regarding the type and level of training of an assistant and questions regarding the use of two attending surgeons. The survey was designed and administered using surveymonkey.com. The participants were recruited through email invitation and there were no incentives for participation.

Responses were collected and described qualitatively with percentages. Frequency analysis was used to compare responses using Pearson χ^2 analysis or Fisher exact test where appropriate. Comparisons of responses between the following groups were made: surgeons from the United States and all others (International), academic and private practice, and surgeon experience less than 15 years and those greater than 15 years. All statistical analyses were performed using commercially available software (SPSS v22, IBM, Armonk, NY) and the level of significance was set at $P < 0.05$.

RESULTS

Surgeon Demographics (Questions 1–9)

Both SRS members and candidate members were invited from around the world which included 1005 surgeons. A total of 199 (19.8%) responded from 27 different countries with the majority being from the United States (66.8%, $n=133$); 90.4% ($n=179$) of the respondents reported Orthopedics as their specialty and 98.0% ($n=194$) reported a training level of attending. Approximately, 68.7% ($n=136$) of the respondents have been in practice >10 years with 47.0% ($n=93$) having been in practice for >15 years (Table 1); 85.4% ($n=169$) of the

TABLE 1. Questions 1 to 5 From the 27-Question Survey Administered to Spine Surgeons and the Percent Responses

#	Question	Responses	N (%)
1	Country where you practice:	Numerous responses	NA
2	Type of specialty	Orthopaedic Surgery	179 (90.4)
		Neurosurgery	19 (9.6)
		Total	198 (100)
3	Level of training	Resident	1 (0.5)
		Fellow	3 (1.5)
		Attending	194 (98.0)
		Total	198 (100)
4	Type of practice	Academic	135 (68.2)
		Private Practice	50 (25.3)
		Other	13 (6.6)
		Total	198 (100)
5	Years in practice	<5 years	24 (12.1)
		5–10 years	38 (19.2)
		10–15 years	43 (21.7)
		>15 years	93 (47.0)
		Total	198 (100)

respondents reported that $\geq 26\%$ of their practice involves deformity with 43.4% ($n=86$) having $\geq 51\%$ of their practice involving deformity. Practice types included: 68.2% ($n=135$) academic practices, 25.3% ($n=50$) private practice, and 6.6% ($n=13$) from "other." Moreover, 51.3% ($n=102$) and 36.0% ($n=71$) of respondents stated that $\geq 51\%$ of their deformity practice involves adult patients or pediatrics, respectively. Most of the respondents (52.5%, $n=104$) perform one to 10 three-column osteotomies per year with 8.6% ($n=17$) performing ≥ 25 per year.

The international surgeons and those in an academic setting both had a significantly higher distribution of their practice involving deformity ($\geq 51\%$ of practice), than the surgeons from the US or in private practice, respectively (61.4% *vs.* 34.8%, and 53.0% *vs.* 20.0%, $P < 0.01$ for both, Table 2 in online version). However, the US surgeons and those in private practice had a significantly greater distribution of their deformity practice involving adults ($\geq 51\%$ of practice), than the international and academic surgeons (63.2% *vs.* 28.2%,

and 70.0% *vs.* 45.3%, $P < 0.01$ for both, Table 2 in online version). Thus the international and academic surgeons had a significantly higher distribution of their deformity practice involving pediatrics ($\geq 51\%$ of practice), than the US and private practice surgeons (51.0% *vs.* 28.8%, and 41.4% *vs.* 18.0%, $P < 0.01$ for both, Table 2 in online version).

The number of years in practice (> 15 yrs *vs.* < 15 yrs) did not significantly impact the distribution of the following practice patterns: deformity ($P = 0.57$), adults ($P = 0.88$), or pediatrics ($P = 0.92$). In addition, there were no significant differences between the groups for the number of 3-column osteotomies performed each year ($P > 0.05$ for all, Table 2 in online version).

Assistant Characteristics (Questions 10–16)

Overall, a few of the respondents (7.1%) have a junior level resident, a senior level resident (15.2%), or a physician assistant /nurse practitioner (15.1%) as their only assistant $\geq 51\%$ of the time (Table 3 in online version). Of the

TABLE 2. Questions 6 to 9 From the 27-Question Survey Administered to Spine Surgeons and the Percent Responses for Each Group

#	Question	Responses	Number (%)						
			All	International	US	Academic	Private	< 15 Years	> 15 Years
6	What percent of your practice is deformity?	0	0 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		1–25	29 (14.6)	4 (7)	23 (17.4)	9 (6.7)	15 (30)	18 (17.1)	11 (12)
		26–50	83 (41.9)	18 (31.6)	63 (47.7)	54 (40.3)	25 (50)	47 (44.8)	36 (39.1)
		51–75	42 (21.2)	17 (29.8)	24 (18.2)	34 (25.4)	4 (8)	19 (18.1)	23 (25)
		76–99	36 (18.2)	16 (28.1)	16 (12.1)	30 (22.4)	5 (10)	17 (16.2)	19 (20.7)
		100	8 (4.0)	2 (3.5)	6 (4.5)	7 (5.2)	1 (2)	4 (3.8)	3 (3.3)
		Total	198 (100)	57 (100)	132 (100)	134 (100)	50 (100)	105 (100)	92 (100)
		<i>P</i>	NA	<0.01		<0.01		0.57	
7	What percent of your deformity practice is adults?	0	24 (12.1)	3 (5.3)	20 (15)	18 (13.3)	3 (6)	14 (13.3)	9 (9.7)
		1–25	46 (23.1)	23 (40.4)	20 (15)	36 (26.7)	6 (12)	24 (22.9)	22 (23.7)
		26–50	27 (13.6)	15 (26.3)	9 (6.8)	20 (14.8)	6 (12)	14 (13.3)	13 (14)
		51–75	25 (12.6)	12 (21.1)	13 (9.8)	16 (11.9)	7 (14)	11 (10.5)	14 (15.1)
		76–99	55 (27.6)	3 (5.3)	50 (37.6)	29 (21.5)	23 (46)	31 (29.5)	24 (25.8)
		100	22 (11.1)	1 (1.8)	21 (15.8)	16 (11.9)	5 (10)	11 (10.5)	11 (11.8)
		Total	199 (100)	57 (100)	133 (100)	135 (100)	50 (100)	105 (100)	93 (100)
		<i>P</i>	NA	<0.01		0.02		0.88	
8	What percent of your deformity practice is pediatric?	0	22 (11.2)	1 (1.8)	21 (15.9)	16 (12)	5 (10)	11 (10.7)	11 (11.8)
		1–25	72 (36.5)	11 (19.3)	59 (44.7)	39 (29.3)	28 (56)	39 (37.9)	33 (35.5)
		26–50	32 (16.2)	16 (28.1)	14 (10.6)	23 (17.3)	8 (16)	16 (15.5)	16 (17.2)
		51–75	16 (8.1)	12 (21.1)	3 (2.3)	13 (9.8)	3 (6)	7 (6.8)	9 (9.7)
		76–99	33 (16.8)	14 (24.6)	17 (12.9)	25 (18.8)	3 (6)	17 (16.5)	16 (17.2)
		100	22 (11.2)	3 (5.3)	18 (13.6)	17 (12.8)	3 (6)	13 (12.6)	8 (8.6)
		Total	197 (100)	57 (100)	132 (100)	133 (100)	50 (100)	103 (100)	93 (100)
		<i>P</i>	NA	<0.01		0.02		0.92	
9	What is the number of 3-column osteotomies you do per year?	None	18 (9.1)	4 (7)	14 (10.6)	9 (6.7)	6 (12)	9 (8.7)	9 (9.7)
		1–10	104 (52.5)	33 (57.9)	64 (48.5)	62 (46.3)	32 (64)	50 (48.1)	53 (57)
		10–25	59 (29.8)	15 (26.3)	43 (32.6)	48 (35.8)	10 (20)	36 (34.6)	23 (24.7)
		25–50	13 (6.6)	2 (3.5)	10 (7.6)	11 (8.2)	2 (4)	5 (4.8)	8 (8.6)
		>50	4 (2.0)	3 (5.3)	1 (0.8)	4 (3)	0 (0)	4 (3.8)	0 (0)
		Total	198 (100)	57 (100)	132 (100)	134 (100)	50 (100)	104 (100)	93 (100)
		<i>P</i>	NA	0.16		0.07		0.13	

TABLE 3. Questions 10 to 16 From the 27-Question Survey Administered to Spine Surgeons and the Percent Responses for Each Group

#	Question	Responses	Number (%)						
			All	International	US	Academic	Private	< 15 Years	> 15 Years
10	What percent of cases are with a junior level resident (i.e., 3 or fewer years of experience) as your only assistant?	0	103 (52.3)	30 (53.6)	68 (51.5)	52 (39.1)	41 (82)	49 (46.7)	54 (58.7)
		1–25	63 (32.0)	15 (26.8)	46 (34.8)	53 (39.8)	7 (14)	38 (36.2)	25 (27.2)
		26–50	17 (8.6)	4 (7.1)	11 (8.3)	14 (10.5)	2 (4)	9 (8.6)	8 (8.7)
		51–75	5 (2.5)	1 (1.8)	4 (3)	5 (3.8)	0 (0)	4 (3.8)	1 (1.1)
		76–99	4 (2.0)	3 (5.4)	1 (0.8)	4 (3)	0 (0)	2 (1.9)	2 (2.2)
		100	5 (2.5)	3 (5.4)	2 (1.5)	5 (3.8)	0 (0)	3 (2.9)	2 (2.2)
		Total	197 (100)	56 (100)	132 (100)	133 (100)	50 (100)	105 (100)	92 (100)
		P	NA	0.21		<0.01		0.53	
11	What percent of cases are with a senior level resident (i.e., >3 years of experience) as your only assistant?	0	83 (41.9)	24 (42.9)	56 (42.1)	35 (26.1)	39 (78)	37 (35.6)	46 (49.5)
		1–25	53 (26.8)	14 (25)	36 (27.1)	44 (32.8)	7 (14)	34 (32.7)	19 (20.4)
		26–50	32 (16.2)	7 (12.5)	23 (17.3)	28 (20.9)	2 (4)	17 (16.3)	14 (15.1)
		51–75	12 (6.1)	4 (7.1)	8 (6)	12 (9)	0 (0)	6 (5.8)	6 (6.5)
		76–99	10 (5.1)	4 (7.1)	6 (4.5)	10 (7.5)	0 (0)	5 (4.8)	5 (5.4)
		100	8 (4.0)	3 (5.4)	4 (3)	5 (3.7)	2 (4)	5 (4.8)	3 (3.2)
		Total	198 (100)	56 (100)	133 (100)	134 (100)	50 (100)	104 (100)	93 (100)
		P	NA	0.87		<0.01		0.37	
12	What percent of cases are with a fellow as your only assistant?	0	86 (43.9)	15 (27.3)	66 (50)	44 (32.8)	34 (70.8)	45 (42.9)	41 (45.6)
		1–25	47 (24.0)	23 (41.8)	22 (16.7)	38 (28.4)	6 (12.5)	33 (31.4)	14 (15.6)
		26–50	31 (15.8)	7 (12.7)	23 (17.4)	24 (17.9)	5 (10.4)	13 (12.4)	18 (20)
		51–75	14 (7.1)	2 (3.6)	11 (8.3)	12 (9)	1 (2.1)	9 (8.6)	4 (4.4)
		76–99	11 (5.6)	4 (7.3)	7 (5.3)	9 (6.7)	2 (4.2)	3 (2.9)	8 (8.9)
		100	7 (3.6)	4 (7.3)	3 (2.3)	7 (5.2)	0 (0)	2 (1.9)	5 (5.6)
		Total	196 (100)	55 (100)	132 (100)	134 (100)	48 (100)	105 (100)	90 (100)
		P	NA	<0.01		<0.01		0.02	
13	What percent of cases are with a physician assistant / nurse practitioner as your only assistant?	0	131 (65.8)	48 (84.2)	78 (58.6)	107 (79.3)	17 (34)	75 (71.4)	55 (59.1)
		1–25	28 (14.1)	5 (8.8)	22 (16.5)	19 (14.1)	6 (12)	16 (15.2)	12 (12.9)
		26–50	10 (5.0)	1 (1.8)	8 (6)	3 (2.2)	7 (14)	2 (1.9)	8 (8.6)
		51–75	3 (1.5)	0 (0)	3 (2.3)	1 (0.7)	2 (4)	2 (1.9)	1 (1.1)
		76–99	10 (5.0)	1 (1.8)	8 (6)	2 (1.5)	8 (16)	5 (4.8)	5 (5.4)
		100	17 (8.5)	2 (3.5)	14 (10.5)	3 (2.2)	10 (20)	5 (4.8)	12 (12.9)
		Total	199 (100)	57 (100)	133 (100)	135 (100)	50 (100)	105 (100)	93 (100)
		P	NA	0.03		<0.01		0.08	
14	How many years of experience for your physician assistant / nurse practitioner?	<5 years	75 (52.1)	23 (59)	47 (48.5)	52 (59.8)	17 (37.8)	46 (59.7)	29 (43.3)
		5–10 years	43 (29.9)	9 (23.1)	32 (33)	18 (20.7)	20 (44.4)	22 (28.6)	21 (31.3)
		10–15 years	14 (9.7)	2 (5.1)	11 (11.3)	9 (10.3)	5 (11.1)	6 (7.8)	8 (11.9)
		>15 years	12 (8.3)	5 (12.8)	7 (7.2)	8 (9.2)	3 (6.7)	3 (3.9)	9 (13.4)
		Total	144 (100)	39 (100)	97 (100)	87 (100)	45 (100)	77 (100)	67 (100)
		P	NA	0.31		0.03		0.09	
15	What percent of cases are with another attending as your only assistant?	0	66 (33.2)	16 (28.1)	48 (36.1)	44 (32.6)	18 (36)	27 (25.7)	39 (41.9)
		1–25	68 (34.2)	16 (28.1)	49 (36.8)	49 (36.3)	13 (26)	36 (34.3)	31 (33.3)
		26–50	17 (8.5)	5 (8.8)	12 (9)	14 (10.4)	3 (6)	12 (11.4)	5 (5.4)
		51–75	15 (7.5)	6 (10.5)	8 (6)	11 (8.1)	3 (6)	9 (8.6)	6 (6.5)
		76–99	18 (9.0)	7 (12.3)	9 (6.8)	8 (5.9)	7 (14)	13 (12.4)	5 (5.4)
		100	15 (7.5)	7 (12.3)	7 (5.3)	9 (6.7)	6 (12)	8 (7.6)	7 (7.5)
		Total	199 (100)	57 (100)	133 (100)	135 (100)	50 (100)	105 (100)	93 (100)
		P	NA	0.23		0.26		0.11	

TABLE 3 (Continued)

#	Question	Responses	Number (%)						
			All	International	US	Academic	Private	< 15 Years	> 15 Years
16	How many years of experience for your attending?	Not Applicable	55 (28.4)	13 (23.2)	40 (31)	34 (26.2)	16 (32)	24 (23.3)	31 (34.4)
		<5 years	28 (14.4)	13 (23.2)	14 (10.9)	21 (16.2)	3 (6)	17 (16.5)	11 (12.2)
		5–10 years	37 (19.1)	4 (7.1)	29 (22.5)	17 (13.1)	16 (32)	24 (23.3)	13 (14.4)
		10–15 years	27 (13.9)	12 (21.4)	15 (11.6)	23 (17.7)	3 (6)	19 (18.4)	8 (8.9)
		>15 years	47 (24.2)	14 (25)	31 (24)	35 (26.9)	12 (24)	19 (18.4)	27 (30)
		Total	194 (100)	56 (100)	129 (100)	130 (100)	50 (100)	103 (100)	90 (100)
		<i>P</i>	NA	<0.01			0.01		0.06

respondents that answered question 14 regarding the years of experience for their physician assistant/nurse practitioner ($n=144$), most reported the experience being 10 or less years (81.9%). The majority of the respondents (67.3%) reported having an attending as a second surgeon $\leq 25\%$ of the time with 33.2% reported not having one and 32.7% having one $\geq 26\%$ of the time (Figure 1). In this study, 47.4% reported that their second attending surgeon had <15 years of experience with 24.2% reporting >15 years of experience (Table 3 in online version).

For the different respondent groups, the academic surgeons reported having a junior level resident or a senior level resident a significantly higher percentage of time than the private practice surgeons ($P < 0.01$ for both, Table 3 in online version). Both the international surgeons and the academic surgeons reported having a fellow as their only assistant significantly more than the US surgeons and the private practice surgeons (72.7% *vs.* 50.0%, and 67.2% *vs.* 29.2%, respectively, $P < 0.01$ for both, Table 3 in online version). Conversely, the US surgeons and the private practice surgeons have a physician assistant/nurse practitioner as their only assistant a significantly greater percentage of the time than the international and academic surgeons (41.3% *vs.* 15.9%, $P = 0.03$ and 66.0% *vs.* 20.7%, $P < 0.01$, respectively). For the surgeons that have a physician assistant/nurse practitioner as their assistant, the private practice surgeons reported their assistant having significantly more years of experience (>5 years) than the academic surgeons (62.2% *vs.* 40.2%, $P = 0.03$, Table 3). There were no significant differences between the groups for the percent of cases in which another attending was their only assistant ($P > 0.05$ for all); however, both the international surgeons and the academic surgeons reported significantly different distribution of years of experience for the second attending than the US surgeons and private practice surgeons ($P < 0.05$ for both, Table 3 in online version). There were no other significant differences between the respondent groups for questions #10–16 ($P > 0.05$ for all).

Single Versus Two Attending Surgeon (Questions 17–27)

The entire cohort of respondents significantly reported believing that having two attending spine surgeons improves

safety, decreases complications and improves outcomes for all deformity cases and 3-column osteotomy and difficult cases (questions #17–20, $P < 0.01$ for all, Figure 2). Almost half of the respondents (48.2%) reported that the second attending was of the same specialty $\geq 51\%$ of time, where only 13.8% reported the second attending was from a different specialty (Table 4). Overall, the respondents were about split evenly on believing that two attendings negatively impacts resident and fellow training (52% yes, 48% no). From the total number of respondents, 33.8% feel that the use of a second surgeon is limited by both reimbursement and access concerns (Figure 3) and of the respondents in which this question applied ($n = 131$), 51.1% felt the use of a second surgeons is limited by both. Access concerns referred to surgeon availability because of busy clinical schedules. From the total cohort, 41.8% reported any percent of cases (1%–100%) having difficulty getting the second attending reimbursed as the cosurgeon (Table 4), and of those in which this question applied ($n = 114$), 71.9% reported having difficulty. The majority of respondents (58.4%) agreed that the reasons for having an attending as their co-surgeon were for “all of the above” for question #26 (Table 4) and of those in which this question was applicable ($n = 159$), the percentage for “all of the above” was 72.3% (Figure 4). There were similar responses for whether the respondents would use a second attending surgeon the same amount, more often, or always if the reimbursement was equal and assured (23.7%–28.8%, Table 4).

Regarding the different respondent groups, the international surgeons agreed that two attending surgeons improves safety, decreases complications, and improves outcomes in all deformity cases (86% and 80.7%, respectively) and improves outcomes for 3-column osteotomy and difficult cases (91.2%) significantly more than the US surgeons (62.3%, 50.8%, and 78.2%, respectively, $P < 0.05$ for all, Table 4). The US surgeons reported that the second attending was of a different specialty $\geq 51\%$ of time significantly more than the international surgeons (16.2% *vs.* 7.1%, $P = 0.02$). Both the academic surgeons and the surgeons with <15 years of experience agreed significantly more often that a second attending surgeon negatively

TABLE 4. Questions 17 to 27 From the 27-Question Survey Administered to Spine Surgeons and the Percent Responses for Each Group

#	Question	Responses	Number (%)						
			All	International	US	Academic	Private	< 15 Years	> 15 Years
17	Do you believe surgery with two attendings improves safety and decreases complications in all adult deformity cases?	Yes	137 (69.9)	49 (86)	81 (62.3)	94 (71.2)	33 (66)	73 (70.2)	63 (69.2)
		No	59 (30.1)	8 (14)	49 (37.7)	38 (28.8)	17 (34)	31 (29.8)	28 (30.8)
		Total	196 (100)	57 (100)	130 (100)	132 (100)	50 (100)	104 (100)	91 (100)
		P	<0.01	<0.01	0.49	0.88			
18	Do you believe surgery with two attendings improves safety and decreases complications in 3-column osteotomy and difficult cases?	Yes	168 (84.4)	52 (91.2)	109 (82)	115 (85.2)	41 (82)	90 (85.7)	77 (82.8)
		No	31 (15.6)	5 (8.8)	24 (18)	20 (14.8)	9 (18)	15 (14.3)	16 (17.2)
		Total	199 (100)	57 (100)	133 (100)	135 (100)	50 (100)	105 (100)	93 (100)
		P	P	<0.01	0.10	0.60			0.57
19	Do you believe surgery with two attendings improves outcomes in all adult deformity cases?	Yes	118 (60.8)	46 (80.7)	65 (50.8)	80 (61.1)	32 (64)	60 (58.3)	57 (63.3)
		No	76 (39.2)	11 (19.3)	63 (49.2)	51 (38.9)	18 (36)	43 (41.7)	33 (36.7)
		Total	194 (100)	57 (100)	128 (100)	131 (100)	50 (100)	103 (100)	90 (100)
		P	<0.01	<0.01	0.72	0.47			
20	Do you believe surgery with two attendings improves outcomes in 3-column osteotomy and difficult cases?	Yes	163 (82.3)	52 (91.2)	104 (78.2)	110 (82.1)	41 (82)	86 (82.7)	76 (81.7)
		No	35 (17.7)	5 (8.8)	29 (21.8)	24 (17.9)	9 (18)	18 (17.3)	17 (18.3)
		Total	198 (100)	57 (100)	133 (100)	134 (100)	50 (100)	104 (100)	93 (100)
		P	P	<0.01	0.03	0.99			0.86
21	What percent of your cases that have another attending as your only assistant is the second attending in the same specialty as you (ortho with ortho and neuro with neuro)?	0	66 (33.8)	16 (28.1)	48 (36.9)	43 (32.6)	18 (36.7)	29 (28.2)	37 (40.7)
		1-25	21 (10.8)	4 (7)	16 (12.3)	15 (11.4)	5 (10.2)	13 (12.6)	8 (8.8)
		26-50	14 (7.2)	7 (12.3)	7 (5.4)	8 (6.1)	4 (8.2)	8 (7.8)	6 (6.6)
		51-75	13 (6.7)	4 (7)	9 (6.9)	9 (6.8)	4 (8.2)	10 (9.7)	3 (3.3)
		76-99	36 (18.5)	10 (17.5)	23 (17.7)	28 (21.2)	5 (10.2)	20 (19.4)	15 (16.5)
		100	45 (23.1)	16 (28.1)	27 (20.8)	29 (22)	13 (26.5)	23 (22.3)	22 (24.2)
		Total	195 (100)	57 (100)	130 (100)	132 (100)	49 (100)	103 (100)	91 (100)
		P	NA	0.37		0.66		0.28	
		0	101 (51.5)	37 (64.9)	59 (45.4)	72 (54.5)	23 (46)	49 (47.1)	52 (57.1)
		1-25	55 (28.1)	15 (26.3)	38 (29.2)	38 (28.8)	12 (24)	30 (28.8)	24 (26.4)
22	What percent of your cases that have another attending as your only assistant is the second attending in a different specialty as you (ortho with neuro and vice versa)?	26-50	13 (6.6)	1 (1.8)	12 (9.2)	7 (5.3)	5 (10)	8 (7.7)	5 (5.5)
		51-75	6 (3.1)	3 (5.3)	3 (2.3)	5 (3.8)	1 (2)	2 (1.9)	4 (4.4)
		76-99	10 (5.1)	1 (1.8)	8 (6.2)	6 (4.5)	3 (6)	8 (7.7)	2 (2.2)
		100	11 (5.6)	0 (0)	10 (7.7)	4 (3)	6 (12)	7 (6.7)	4 (4.4)
		Total	196 (100)	57 (100)	130 (100)	132 (100)	50 (100)	104 (100)	91 (100)
		P	NA	0.02		0.17		0.34	
		0	101 (51.5)	37 (64.9)	59 (45.4)	72 (54.5)	23 (46)	49 (47.1)	52 (57.1)
		1-25	55 (28.1)	15 (26.3)	38 (29.2)	38 (28.8)	12 (24)	30 (28.8)	24 (26.4)

TABLE 4 (Continued)

#	Question	Responses	Number (%)						
			All	International	US	Academic	Private	< 15 Years	> 15 Years
23	Do you believe surgery with two attendings negatively impacts resident and fellow training?	Yes	103 (52.0)	29 (50.9)	70 (53)	79 (59)	18 (36)	64 (61.5)	39 (41.9)
		No	95 (48.0)	28 (49.1)	62 (47)	55 (41)	32 (64)	40 (38.5)	54 (58.1)
		Total	198 (100)	57 (100)	132 (100)	134 (100)	50 (100)	104 (100)	93 (100)
		P	NA	0.79	<0.01	<0.01			
		Reimbursement	23 (11.6)	5 (8.8)	17 (12.9)	11 (8.2)	9 (18)	11 (10.6)	12 (12.9)
24	In your practice, do you feel the use of a second surgeon is limited by:	Access concerns	18 (9.1)	5 (8.8)	13 (9.8)	14 (10.4)	1 (2)	11 (10.6)	6 (6.5)
		Both	67 (33.8)	18 (31.6)	46 (34.8)	47 (35.1)	19 (38)	42 (40.4)	25 (26.9)
		Other	23 (11.6)	2 (3.5)	18 (13.6)	16 (11.9)	4 (8)	9 (8.7)	14 (15.1)
		Not Applicable	67 (33.8)	27 (47.4)	38 (28.8)	46 (34.3)	17 (34)	31 (29.8)	36 (38.7)
		Total	198 (100)	57 (100)	132 (100)	134 (100)	50 (100)	104 (100)	93 (100)
		P	NA	0.07		0.14		0.15	
			32 (16.3)	12 (21.1)	18 (13.8)	23 (17.4)	8 (16)	18 (17.5)	14 (15.2)
25	If you have an attending as your co-surgeon, what percent of cases do you have difficulty getting the second attending reimbursed as the co-surgeon?	1–25	25 (12.8)	4 (7)	20 (15.4)	15 (11.4)	10 (20)	15 (14.6)	10 (10.9)
		26–50	22 (11.2)	5 (8.8)	16 (12.3)	13 (9.8)	7 (14)	9 (8.7)	13 (14.1)
		51–75	11 (5.6)	2 (3.5)	9 (6.9)	6 (4.5)	4 (8)	6 (5.8)	5 (5.4)
		76–99	11 (5.6)	3 (5.3)	8 (6.2)	7 (5.3)	4 (8)	6 (5.8)	5 (5.4)
		100	13 (6.6)	3 (5.3)	9 (6.9)	9 (6.8)	2 (4)	7 (6.8)	6 (6.5)
		Not Applicable	82 (41.8)	28 (49.1)	50 (38.5)	59 (44.7)	15 (30)	42 (40.8)	39 (42.4)
		Total	196 (100)	57 (100)	130 (100)	132 (100)	50 (100)	103 (100)	92 (100)
		P	NA	0.43		0.40		0.92	
		It's safer/reduces complications	29 (14.7)	14 (24.6)	15 (11.5)	24 (18.2)	4 (8)	18 (17.5)	11 (12)
		It decreases operative time	29 (14.7)	13 (22.8)	15 (11.5)	23 (17.4)	5 (10)	18 (17.5)	11 (12)
26*	If you have an attending as your co-surgeon, what are the reasons you do so: (select all that apply)	It decreases blood loss	14 (7.1)	7 (12.3)	7 (5.4)	12 (9.1)	2 (4)	8 (7.8)	6 (6.5)
		It results in improved outcomes	12 (6.1)	6 (10.5)	6 (4.6)	9 (6.8)	3 (6)	9 (8.7)	3 (3.3)
		It's less work and stress for me	24 (12.2)	10 (17.5)	14 (10.8)	18 (13.6)	4 (8)	15 (14.6)	9 (9.8)
		All of the above	115 (58.4)	33 (57.9)	76 (58.5)	74 (56.1)	33 (66)	61 (59.2)	53 (57.6)
		Not applicable	38 (19.3)	7 (12.3)	29 (22.3)	25 (18.9)	9 (18)	14 (13.6)	24 (26.1)
		Total	197 (100)*	57 (100)*	130 (100)*	132 (100)*	50 (100)*	103 (100)*	92 (100)*
		P	NA	0.01		0.20		0.22	

TABLE 4 (Continued)

#	Question	Responses	Number (%)				
			All	International	US	Academic	Private
ss27	If you have an attending as your co-surgeon and if reimbursement was equal and assured for the second attending surgeon, I would use a second surgeon:	Same amount	50 (25.3)	10 (17.5)	39 (29.5)	38 (28.4)	11 (22)
		More often	57 (28.8)	12 (21.1)	42 (31.8)	37 (27.6)	16 (32)
		Always	47 (23.7)	14 (24.6)	29 (22)	27 (20.1)	16 (32)
		Not Applicable	44 (22.2)	21 (36.8)	22 (16.7)	32 (23.9)	7 (14)
		Total	198 (100)	57 (100)	132 (100)	134 (100)	50 (100)
		P	NA	0.01		0.20	0.22

*Note: for question 26, the numbers and percentages will not add up to the totals listed because of multiple selections from the "select all that apply" design of the question. The percentages listed are out of the total number of respondents that answered the question. Lastly, the counts of the individual selections are only those in which the respondent did not also select "all of the above" as any duplicates (i.e. selection of 1 or more options and "all of the above" were excluded and only the "all of the above" selection was counted).

What percent of cases are with another attending as your only assistant?

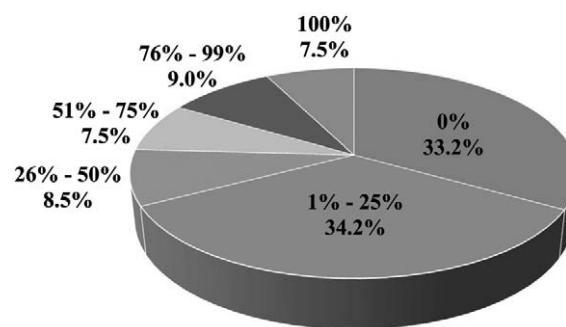


Figure 1. The percentage of respondents that have another attending surgeon as their only assistant for the listed percentages of time (question #15).

impacts resident and fellow education compared with the private practice surgeons and those with >15 years of experience (59.0% *vs.* 36.0%, and 61.5% *vs.* 41.9%, respectively, $P < 0.01$ for both, Table 4). The international surgeons selected the individual options for question #26 more often than the US surgeons ($P = 0.01$), but both groups had similar selections for "all of the above" (Table 4). Note that the counts of the individual selections are only those in which the respondent did not also select "all of the above" as any duplicates (*i.e.*, selection of 1 or more options and "all of the above" were excluded and only the "all of the above" selection was counted). There were no other significant differences between the respondent groups for questions #17–27 ($P > 0.05$ for all, Table 4).

DISCUSSION

The operative management of adult spinal deformity continues to be complex and very challenging with higher than desired complication rates. Every effort is made to improve the safety of the patients and a recent approach includes the use of two attending surgeons. An international electronic survey was conducted to evaluate the current practice patterns and views regarding the use of two attending surgeons.

Overall, the respondents felt that having a second attending surgeon improves patient safety and outcomes. However, most of the respondents do not use a second attending often and this was true across the different groups. For those that use a second attending surgeon, 51.1% felt using a second attending is limited by both access concerns and reimbursement and 71.9% reported difficulty in getting the second attending reimbursed as the cosurgeon. By access, we are referring to surgeon availability because of busy clinical schedules and reimbursement refers to payment for services rendered. Despite these challenges, those that attempt to use a second attending, 72.3% do so for ALL of the following reasons: "it's safer/reduces complications," "it decreases operative time," "it decreases blood loss," "it results in improved outcomes," "it's less work and stress for me." And lastly, if reimbursement was equal and assured for a second attending, 67.5% would

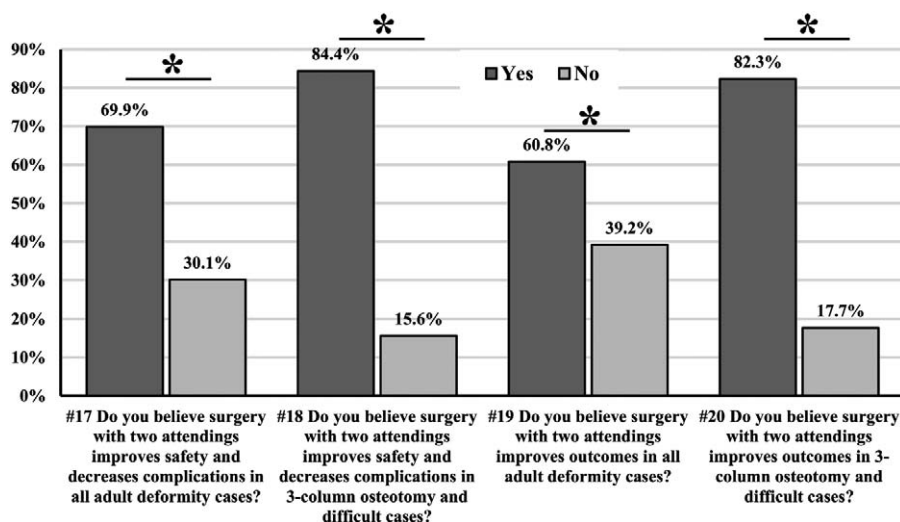


Figure 2. The percentage of respondents answering “yes” or “no” for questions #17 through #20 regarding their opinion on the use of another attending reducing complications and improving outcomes. (*) indicates statistical significance between responses with $P < 0.01$ for all.

use one “more often” or “always,” which was also similar between all of the groups.

The results suggest that there is a strong belief among the surgeons surveyed that having a dual attending surgeon approach is very beneficial to patient care. A few studies have looked at the complication rates after such an approach. Ames *et al*³³ investigated the perioperative outcomes for single *versus* dual attending surgeons in adult spinal deformity, specifically patients undergoing 3-column osteotomies notorious for a high complication rate.^{22–26} The groups were similar in mean number of posterior levels fused and levels decompressed and the dual surgeon group resulted in significantly lower mean percent blood loss (35% *vs.* 109%), shorter mean operative time (5.0 *vs.* 7.6 hours), and a lower complication rate (25% *vs.* 45% for minimum 1 major complication).³³ Moreover, the dual surgeon group had an 8% rate of unplanned surgery within 30 days whereas the single surgeon group had a rate of 19%. This was the first study in adults and in complex 3-column osteotomy surgeries. This study strongly demonstrated a large decrease in complication rates. Sethi *et al*³⁴ expanded upon this with a systems based approach that included a multidisciplinary preoperative screening

conference, an intraoperative coagulopathy protocol, and dual attending surgeons. The patient groups were similar in regards to age, number of levels fused, staging, and 3-column osteotomies. Similarly, this approach demonstrated improved patient safety by having significantly lower rates for the following: complications (16% *vs.* 52%), 90-day reoperation (0.8% *vs.* 12.5%), wound infection requiring debridement (1.6% *vs.* 7.5%), deep vein thrombosis/pulmonary embolism (3.2% *vs.* 10%), and urinary tract infection requiring antibiotics (9.7% *vs.* 32.5%). This study was the most comprehensive to date and included all forms of ASD patients further adding to the evidence that a dual surgeon approach can greatly improve patient safety. This Seattle based group has used its outcomes in spinal surgery to negotiate national contracts for their best practices including contracts from large multinational corporations looking for less variability and more consistent outcomes.³⁵

Although these recent studies show promise in reducing complications for ASD surgery and the significant majority of surgeons surveyed in the current study believe that two attending surgeons offers great benefit for the patients, most

In your practice, do you feel the use of a second surgeon is limited by:

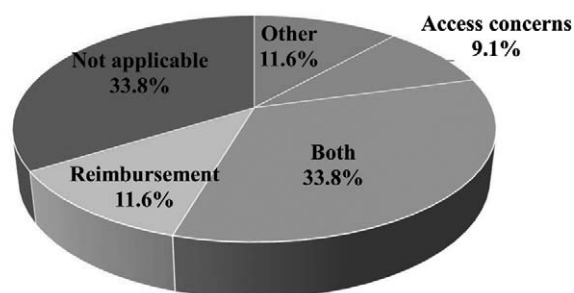


Figure 3. The percentage of respondents that feel the listed reasons for limited use of a second surgeon (question #24).

If you have an attending as your co-surgeon, what are the reasons you do so: (select all that apply)

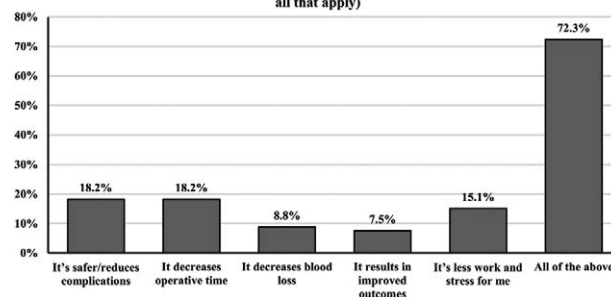


Figure 4. The percentage of respondents that have an attending surgeon as their co-surgeon for the listed reasons (question #26). Note, the 19.3% ($n = 38$) of surgeons that responded “not applicable” were excluded from the percentage calculations and that the percentages will not add up 100% because of overlapping selections.

still do not. This practice appears to be limited to a few select centers and the surgeons surveyed agreed reimbursement for the second attending was difficult to secure. Healthcare costs in the United States continue to rise and within the discussion of reform, physician reimbursement has been targeted as a way to reduce costs and thus, been substantially reduced³⁶ whereas simultaneously, the operating room costs have increased.³⁷ Furthermore, patients believe spine surgeons should be paid 10 to 20 times more than the current Medicare reimbursement rates.³⁸ Given that reimbursement is a challenge for a single surgeon, it is not surprising that having a dual surgeon approach for the same patient would also have reimbursement challenges. In an era of reform and a focus on value-based care, specifically clinical outcomes,³⁹ the above studies represent a beginning to alert third-party payers that the dual attending approach may be of significant benefit to patients safety. The present study adds to the evidence that practicing surgeons from around the world agree with this approach and would use it more often if reimbursement was secured. Larger, prospective studies are needed to likely influence policy, however these studies, including the present one, create the foundation in which future work can expand this much needed area of spine surgery outcomes research.

There are several strengths to the current study. A relatively large number of surgeons were sampled from many different countries around the world. This aids in the generalizability of the results and provide insight into the international practices. Furthermore, the survey was electronically created and distributed, which allows for faster and more accurate collection and analysis of the data. Limitations include the population of the surgeons being varied and not all practiced adult spinal deformity surgery equally and with the same amount of experience. In addition, the response rate was relatively low. Bias is introduced with responders possibly favoring the dual surgeon approach. Survey studies, by design, have an inherent difficulty in receiving responses and for the current study, a reminder email was sent 5 times. However, a total of 199 surgeons from 27 nations remains a large sample size and the results should not be discounted because of the response rate. It's also worth noting that other survey based studies with low response rates have been published (20%, 25%, and 31%).^{40–42} We also would make this study stronger in the future by defining clinical scenarios defining why a second surgeon was necessary. This study was meant to assess the views of practicing surgeons as an aid to discussions surrounding the use of dual attending surgeons for ASD and for third party payers. Although the large majority of respondents feel that a second attending surgeon is beneficial, it is also important to note that an experienced nurse practitioner/physician assistant can also have a positive impact on patient outcomes. Lastly, the methodology of this study is such that the results should be interpreted as a measurement of opinion and should not be interpreted as scientific fact or validation.

CONCLUSION

The results of this study provide insight from the practicing surgeons' perspective regarding the use of two attending surgeons in the operative management of adult spinal deformity. The surgeons surveyed feel that having a second attending surgeon is beneficial for improved patient care, however most of them do not use one often. Reasons include reimbursement/access concerns and the majority would use one if reimbursement for services rendered was equal.

➤ Key Points

- ❑ The respondents significantly reported believing that two attending spine surgeons improves safety, decreases complications, and improves outcomes for both "all deformity cases" and "3-column osteotomy/difficult cases."
- ❑ Most of the respondents did not frequently utilize a second attending surgeon.
- ❑ For those that use a second attending surgeon, 51.1% felt using a second attending is limited by both access concerns and reimbursement and 71.9% reported difficulty in getting the second attending reimbursed as the cosurgeon.
- ❑ Those that attempt to use a second attending, 72.3% use a second attending for ALL of the following reasons: "it's safer/reduces complications," "it decreases operative time," "it decreases blood loss," "it results in improved outcomes," "it's less work and stress for me."
- ❑ If reimbursement was equal/assured for a second attending, 67.5% would use one "more often" or "always."

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