

The Effects of Establishing the Spine Surgery Section within Turkish Neurosurgical Society on the Number and Quality of the Spinal Papers Presented at the Annual Meetings of Turkish Neurosurgical Society

Spinal Cerrahi Grubu'nun Kurulmasının Türk Nöroşirürji Derneği Kongrelerinde Sunulan Spinal Bildirilerin Sayı ve Kalitesine Etkisi

SAİT NADERİ, MEHMET ŞENOĞLU, SİBEL KIRAN*

Department of Neurosurgery, Dokuz Eylül University School of Medicine, İzmir, Turkey (SN, MŞ)
Department of Public Health, Dokuz Eylül University School of Medicine, İzmir, Turkey (SK)

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Abstract: Objective: There has been much progress in spinal surgery over the past two decades. These advances have increased the quality and number of spine-related studies, and the number of papers presented at annual meetings of neurosurgical societies. The Spinal Surgery Section (SSS) of the Turkish Neurosurgical Society (TNS) was established in December 1995. The aim of this study was to compare the number of spine-related papers presented at TNS annual meetings before (1991 through 1995) and after (1996 through 2001) the SSS was established.

Materials and Methods: The number of neurosurgeons was strongly correlated with the number of spine related papers, and also with the number of papers on spinal instrumentation. However, after the control of these correlations for a year and total number of papers, the relation between the increase in the number of neurosurgeons and spinal papers, as well as the relation between the increase in the number of neurosurgeons and spinal instrumentation related papers decreased.

Results: After the SSS was established, there were significantly higher numbers of presented papers concerning spinal tumor, degenerative spinal disease, spinal instrumentation, and spinal laboratory studies ($p=0.017$, $p=0.011$, $p=0.044$, and $p=0.027$, respectively). In contrast, the numbers of presented papers related to spinal trauma and spinal infection ($p=0.067$ and $p=0.099$, respectively) did not change significantly.

Özet: Amaç: Spinal cerrahide son iki dekadta önemli ilerlemeler kaydedilmiştir. Bu ilerlemenin en önemli kanıtlarından biri spinal cerrahi bildirilerinin sayı ve kalitesindeki artıştır. Türk Nöroşirürji Derneğinin Spinal Cerrahi Grubu (SCG) Aralık 1995 yılında kurulmuştur. Bu çalışmanın amacı SCG öncesi (1991-1995) ve sonrası (1996-2001) dönemlerde yayınlanan spinal ile ilişkili bildirilerin durumunu karşılaştırmaktır.

Gereç ve Yöntem: Tüm nöroşirürji bildirileri, spinal bildiriler, spinal travma, spinal tümör, spinal dejeneratif hastalıklar, spinal enfeksiyon, laboratuvar çalışmaları ve spinal enstrümantasyon ile ilgili bildiriler SCG öncesi ve sonrası dönemlerde karşılaştırıldı. Ayrıca spinal bildiriler, spinal enstrümantasyon ile ilgili bildiriler ve nöroşirürjiyen sayısı arasındaki ilişki de karşılaştırıldı.

Bulgular: SCG sonrası spinal tümör ($p: 0.017$), dejeneratif spinal hastalıklar ($p: 0.011$), spinal enstrümantasyon ($p: 0.044$), ve spinal laboratuvar çalışmalar ($p: 0.027$) ile ilgili bildirilerin sayısındaki artış miktarı istatistiksel olarak anlamlı bulundu. SCG kuruluşu öncesi ve sonrası dönemler arasında spinal travma ($p: 0.067$) ve spinal enfeksiyon ($p: 0.099$) ile ilgili bildirilerin miktarı arasındaki fark ise istatistiksel olarak anlamlı bulunmadı.

Yıllık toplam makale sayısındaki artışın etkisi elimine edildiğinde nöroşirürjiyen sayısındaki artış ile spinal ile

The number of neurosurgeons was strongly correlated with the number of spine related papers, and also with the number of papers on spinal instrumentation. However, after the control of these correlations for a year and total number of papers, the relation between the increase in the number of neurosurgeons and spinal papers, as well as the relation between the increase in the number of neurosurgeons and spinal instrumentation related papers decreased.

Conclusion: The larger number of neurosurgeons registered in the TNS is the main reason for the observed rise in the overall numbers of neurosurgical papers. However, the strong correlation between the increase in the number of neurosurgeons and spinal papers, as well as the correlation between the increase in the number of neurosurgeons and spinal instrumentation related papers weaken after elimination of the total number of papers. This suggests that other factors contributed to the increase in the number of these papers. Establishment of the SSS within the TNS seems to have had an important impact on the number and quality of spinal procedures in Turkey.

Key Words: Congress, spinal surgery, spine surgery section, subdividing, Turkish neurosurgical society

ilgili bildirlerin sayısı, keza nöroşirürjiyen sayısındaki artış ile spinal enstrümantasyon ile ilgili bildirlerin sayısı arasındaki korelasyonun zayıfladığı görülmüştür.

Tartışma: Nöroşirürji bildirleri sayısındaki artışın temel nedeni nöroşirürjiyen sayısındaki artıştır. Bununla birlikte spinal çalışmalar ve nöroşirürjiyen sayısı arasındaki güçlü korelasyon yıllara göre total nöroşirürji bildiri sayısındaki artış elimine edildiğinde zayıflamaktadır. Bu da spinal bildirilerin sayısındaki artışın yalnızca nöroşirürjiyen sayısındaki artış ile açıklanmayacağını göstermektedir.

Sonuç: Spinal cerrahi grubunun kurulması spinal prosedürlerin kalitesi ve sayısında önemli bir etki görülmesine neden olmuştur.

Anahtar sözcükler: Kongre, seksiyonlaşma, spinal cerrahi, spinal cerrahi grubu, Türk nöroşirürji topluluğu

INTRODUCTION

Spinal surgery has long been a major focus of interest in neurosurgical practice, and neurosurgeons have pioneered many spinal procedures. In particular, the development of new technologies for instrumentation and bone substitutes has led to more complex spinal surgery procedures, and these changes have expanded interest in spinal surgery in the past two decades. As a result, most national neurosurgical societies now have special subdivisions that are focused solely on the spine. The first such subdivision was established within the American Association of Neurological Surgeons (AANS) in 1978, when Dr. Albert Rhoton suggested the idea to Dr. Charles Drake, who was the president of the organization (2). This move led to the establishment of similar subdivisions in national neurosurgical organizations in other countries, including Turkey.

The Spinal Surgery Section (SSS) of the Turkish Neurosurgical Society (TNS) was officially formed in 1994, but was actually introduced to the members of the TNS at the first General Assembly of the SSS in December 1995 at Istanbul (14). The first SSS Executive Committee was elected at this meeting, and the committee began its activities

thereafter. The establishment of this section not only increased Turkish neurosurgeons' interest in spinal surgery, but also led to the organization of numerous symposia. These functions have greatly expanded Turkish neurosurgeons' knowledge of the spine-related sciences.

The aim of this study was to determine the scientific effects that have come from the creation of the SSS within the TNS. To assess this, the numbers of various categories of spine-related papers presented at TNS annual meetings in the 5-year period before and the 6-year period after 1995 (3-13) were compared.

MATERIALS AND METHODS

The data for this study were collected by reviewing the Abstract Books from the TNS annual congresses for the years 1991 to 2001 (11 meetings in total). The pre-SSS period was defined as the "first period" (1991 through 1995), and the period after the section was established was defined as the "second period" (1996 through 2001). In other words, the congress books for the 5 years before and the 6 years after the first General Assembly of the SSS were reviewed and compared.

The following were investigated:

1. Total number of all neurosurgical papers
2. Total number of spine-related papers
3. Total number of spinal trauma-related papers
4. Total number of spinal tumor-related papers
5. Total number of spinal infection-related papers
6. Total number of degenerative spine-related papers
7. Total number of papers on laboratory studies related to the spine
8. Total number of spinal instrumentation-related papers
9. Total numbers of papers relating to each different spinal region before and after creation of the SSS.
10. Relationship between the number of neurosurgeons and the number of spine-related papers
11. Relationship between the number of neurosurgeons and the number of spinal instrumentation-related papers
12. Relationship between the number of spine-related and the number of spinal instrumentation-related papers

Statistical Analysis:

The mean values for the first and second periods were compared using the Mann-Whitney U-test. For each category of papers, the mean number of papers per year within each period was calculated, and these means were compared using the Mann-Whitney U-test. Spearman's correlation testing was used to analyze the relationship between the number of neurosurgeons and the number of spine-related papers; the relationship between the number of neurosurgeons and the number of spinal instrumentation-related papers; and the relationship between the number of spine-related papers and the number of spinal instrumentation-related papers. Also, the aforementioned relationships (listed as 10, 11 and 12 in the list above) were compared after elimination of the increase in the number of total papers.

RESULTS

A total of 1201 (mean 240.2 ± 42.5 ; range 190-298) neurosurgical papers were presented in the first period, and 2235 (mean 372.5 ± 55.4 ; range 303-474) of this type were presented in the second period. The corresponding numbers of spine-related papers were 215 (mean 43.0 ± 28.3) and 649 (108.0 ± 21.6), and this difference was significant ($p=0.006$). Spine-related papers represented 17.9% and 29.0% of all neurosurgical presentations before and after the SSS was established, respectively.

The numbers of papers presented on spinal trauma in the first and second periods were 39 (7.80 ± 7.52) and 90 (15.0 ± 6.26), respectively. The corresponding figures for spinal tumor were 42 (8.40 ± 5.94) and 124 (20.66 ± 5.60); for spinal degenerative disease were 84 (16.80 ± 13.29) and 223 (37.16 ± 6.55); for spinal infection were 19 (3.80 ± 2.58) and 53 (8.83 ± 5.19); for spine-related laboratory studies were 16 (3.80 ± 5.16) and 51 (14 ± 3.52); and for spinal instrumentation were 47 (9.400 ± 11.887) and 181 (30.166 ± 9.43) (Table 1). The mean values in the second period were significantly higher for the categories of spinal tumor ($p=0.017$), spinal degenerative disease ($p=0.011$), spine-related laboratory studies ($p=0.027$) and spinal instrumentation ($p=0.044$). The differences in the mean values for spinal trauma papers ($p=0.067$) and spinal infection papers ($p=0.099$) were not statistically significant.

Spinal Trauma

Of the 39 (7.80 ± 7.52) and 90 (15.0 ± 6.26) spinal trauma papers presented in the first and second periods, respectively, 19 (3.80 ± 3.56) and 50 (8.33 ± 1.86) papers related to the cervical spine; 12 (2.40 ± 3.20) and 28 (4.66 ± 4.67) related to thoracolumbar and thoracic spine trauma; 2 (0.40 ± 0.89) and 5 (0.83 ± 1.16) related to lumbosacral and lumbar spine trauma; and 6 (1.200 ± 1.30) and 7 (1.16 ± 0.75) related to the entire spine. There were also 32 (6.40 ± 8.29) and 67 (11.6 ± 5.81) papers presented on spinal instrumentation for spinal trauma in the first and second periods, respectively. When the trauma papers were grouped according to the spinal level(s) affected, there were no significant differences in the mean numbers of papers presented before and after the SSS was established.

Table 1: The mean number of papers per period for the main categories of spinal pathology investigated (Instr : Instrumentation, SD: Standard deviation, Min: Minimal, Max: Maximum, Lab: Laboratory study related to the spine).

	First period (1991-1995)				Second Period (1996-2001)					
	Mean	SD	Min	Max	Mean	SD	Min	Max	p	z
Spinal	43.0	28.30	13	87	108	21.6	90	150	0.006	-2.73
Trauma	7.80	7.52	3	21	15.0	6.26	10	27	0.067	-1.83
Tumor	8.40	5.94	3	18	20.66	5.60	14	30	0.017	-2.37
Degenerative	16.8	13.29	3	38	37.16	6.55	27	44	0.011	-2.53
Infection	3.80	2.58	1	7	8.83	5.19	2	15	0.099	-1.65
Lab.	3.80	5.16	1	13	14	3.52	10	18	0.027	-2.20
Instr.	9.40	11.88	1	30	30.16	9.43	18	43	0.044	-2.01

Spinal Tumor

Of the 42 (8.40±5.94) and 124 (20.66±5.60) spinal tumor papers presented in the first and second periods, respectively, 11 (2.20±1.92) and 32 (5.33±2.58) discussed tumors of the cervical spine; 7 (1.40±1.67) and 20 (3.33±1.36) discussed tumors of the thoracolumbar and thoracic spine; 9 (1.80±1.30) and 44 (7.33±2.16) discussed tumors of the lumbosacral and lumbar spine; and 15 (3.00±4.00) and 28 (4.66±1.36) discussed tumors affecting the entire spine. There were also 3 (0.60±0.574) and 24 (4.00±3.24) papers presented on spinal instrumentation related to spinal tumors in the first and second periods, respectively.

There were significantly higher numbers of papers presented on cervical (p=0.052) and lumbosacral-lumbar (p=0.006) spinal tumors in the second period than in the first period. The number of papers on instrumentation for spinal tumors (p=0.011) was also significantly higher in the second period. There was no significant change in the number of papers presented on thoracolumbar-thoracic spinal tumors from the first to the second period (p=0.064).

Spinal Degenerative Disease

Of the 84 (16.80±13.29) and 223 (37.16±6.55) papers presented on spinal degenerative disease in the first and second periods, respectively, 16 (3.20±2.16) and 67 (11.16±5.11) related to the cervical spine; 2 (0.40±0.54) and 7 (1.16±1.16)

related to the thoracolumbar and thoracic spine; and 66 (13.20±11.7) and 149 (24.83±3.25) related to the lumbosacral and lumbar spine. There were also 6 (1.200±1.64) and 53 (8.833±5.74) papers presented on spinal instrumentation for spinal degenerative disease in the first and second periods, respectively.

In the second period, there were significantly higher numbers of papers presented on degenerative disease of the cervical spine (p=0.008) and instrumentation for degenerative spinal disease (p=0.009). There were no significant differences in paper numbers between the two periods for degenerative disease of the thoracic-thoracolumbar spine (p=0.238) or lumbar-lumbosacral spine (p=0.100).

Of all the spinal degenerative disease papers presented in the first and second periods, respectively, 55 (11.00±9.35) and 108 (18.00±3.89) papers concerned lumbar disc herniation; 7 (1.40±1.14) and 16 (2.66±1.50) concerned stenosis of the lumbar spine; 4 (0.800±1.30) and 26 (4.33±2.06) concerned degenerative spondylolisthesis; 6 (1.20±1.64) and 50 (8.16±3.60) concerned cervical disc herniation; 10 (2.00±1.87) and 17 (2.83±1.19) concerned cervical spondylotic myelopathy; 2 (0.40±0.54) and 9 (1.16±1.16) concerned thoracic disc herniation; and 0 and 1 (0.16±0.40) concerned cervical spondylolisthesis.

In the second period, there were significantly higher numbers of papers presented on degenerative spondylolisthesis (p=0.012) and

cervical disc herniation (p=0.005), whereas the numbers of papers on lumbar disc herniation (p=0.100), lumbar spinal stenosis (p=0.137), cervical spondyloitic myelopathy (p=0.388), thoracic disc herniation (p=0.238) and cervical spondylolisthesis (p=0.381) were not significantly different (Table 2).

Spinal Infection

Of the 19 (3.80±2.58) and 72 (8.83±5.19) papers presented on spinal infection in the first and second periods, respectively, 1 (0.20±0.44) and 11 (1.66±1.21) papers related to the cervical spine; 3 (0.60±0.54) and 16 (2.16±1.72) related to the thoracolumbar and thoracic spine; 8 (1.60±1.14) and 22 (2.33±1.75) related to the lumbosacral and lumbar spine; and 7 (1.40±1.94) and 23 (2.66±1.96) related to the entire spine. There were also 1 (0.20±0.44) and 16 (2.50±2.88) papers presented on spinal instrumentation for spinal infectious disease in the first and second periods, respectively. In the spinal infection subgroups, the only significant difference was a higher number of papers on infection of the cervical spine (p=0.011) in the second period.

Spine-Related Laboratory Studies

Of the 19 (3.80±5.16) and 101 (14.0±3.52) laboratory studies related to the spine in the first and second periods, respectively, 16 (3.20±4.96) and 67 (8.50±3.27) papers concerned spinal cord trauma models; 3 (0.60±0.54) and 25 (3.66±1.86) were anatomical studies; and 0 and 11 (1.83±1.47) were biomechanical investigations. In the second period, there were significantly higher numbers of laboratory papers related to spinal anatomy (p=0.005) and spinal biomechanics (0.013), but no significant change in the number of papers presented on spinal cord trauma models.

Spinal Instrumentation

Of the 47 (9.40 ±11.88) and 181 (30.16±9.43) papers presented on spinal instrumentation in the first and second periods, respectively, 21 (4.20±5.54) and 100 (13.16±4.83) related to the cervical spine; 14 (2.80±3.70) and 63 (8.16±4.99) related to the thoracolumbar and thoracic spine; 7 (1.40±1.67) and 48 (6.83±3.54) related to the lumbosacral and lumbar spine; and 5 (1.00±1.41) and 12 (2.00±2.28) related to the entire spine (Table 3).

Table 2. The mean number of papers per period for the degenerative pathologies investigated. (LDH: Lumbar disc herniation, LSS: lumbar spine stenosis, DS: degenerative spondylolisthesis, CDH: cervical disc herniation, CSM: cervical spondyloitic myelopathy,TDH: thoracic disc herniation, CS: cervical spondylolisthesis) (SD: Standard deviation, Min: Minimal, Max: Maximum).

	First Period (1991-1995)				Second Period (1996-2001)					
	Mean	SD	Min	Max	Mean	SD	Min	Max	p	z
LDH	11.00	9.354	3	26	18.00	3.898	15	25	0.100	-1.64
LSS	1.400	1.140	0	3	2.660	1.505	0	9	0.137	-1.48
DS	0.800	1.303	0	3	4.33	2.065	2	8	0.012	-2.49
CDH	1.200	1.643	0	3	8.166	3.600	5	14	0.005	-2.78
CSM	2.00	1.870	0	4	2.833	1.940	0	5	0.388	-0.93
TDH	0.400	0.547	0	1	1.166	1.169	0	3	0.238	-1.17
CS	0	0	0	0	0.166	0.408	0	1	0.381	-0.91
Total	16.8	13.29	3	38	37.16	6.55	27	44	0.011	-2.53

Spinal Levels Researched

In the first period, the respective numbers of all types of spine-related papers that dealt with the cervical, thoracolumbar and thoracic, lumbosacral and lumbar, and entire spine were 59 (11.8±7.94), 26 (5.20±3.27), 90 (18.0±12.38), and 37 (7.40±7.16). In the second period, the corresponding numbers were 198 (33.0±6.69), 98 (16.33±8.82), 217 (36.16±5.91), and 92 (15.33±3.38). Comparison of these subgroups revealed significantly higher numbers of papers concerning each spinal level in the second period. Table 4 lists the significant differences between numbers of papers in the two periods for all categories studied.

Relationship Between Number of Neurosurgeons and Number of Spine-Related papers

The number of neurosurgeons registered with the TNS increased during the years covered by the study. A total of 246 neurosurgeons were registered in 1991, and this number increased to 624 by 2001. Figure 1 shows the increases in the numbers of total papers, neurosurgeons, spine-related papers, and papers related to spinal instrumentation from 1991 to 2001.

When raw numbers for both periods were analyzed, the number of neurosurgeons was strongly correlated with the number of spine-related papers (Spearman's $r = 0.891$, $p = 0.000$), and also with the number of papers on spinal

Table 4. The categories and subgroups for which the numbers of presented papers increased significantly from the first to the second period.

All spine-related papers
Spinal tumor:
Cervical spinal tumor
Lumbosacral and lumbar spinal tumor
Instrumentation in spinal tumor
Degenerative spinal disease:
Cervical spinal degenerative disease
Instrumentation in degenerative spinal disease
Degenerative spondylolisthesis
Cervical disc herniation
Infection of the cervical spine
Spine-related laboratory studies:
Anatomical studies
Biomechanical studies
Spinal instrumentation:
Cervical spine
Thoracic-thoracolumbar
Lumbar and lumbosacral

instrumentation (Spearman's $r = 0.624$, $p = 0.008$). However, controlling for the effect of increased total number of papers revealed that the relationship between number of neurosurgeons and number of spine-related papers (partial correlation coefficient = 0.0610, $p = 0.867$); and the relationship between number of neurosurgeons and number of papers related to instrumentation (partial correlation coefficient = 0.1804, $p = 0.618$) were both weaker than indicated above.

Table 3: The mean number of papers per year related to instrumentation at different levels of the spine. (SD: Standard deviation, Min: Minimal, Max: Maximum, Lab: Laboratory study related to the spine).

	First period (1991-1995)				Second Period (1996-2001)						
	Mean	SD	Min	Max	Mean	SD	Min	Max	p	z	
Cervical	4.20	5.540	1	19	13.166	4.833	9	21	0.044	-2.01	
TL + T	2.800	3.701	0	9	8.166	4.996	3	16	0.054	-1.92	
LS + L	1.400	1.673	0	4	6.833	3.544	1	10	0.022	-2.29	
Entire spine	1.00	1.414	0	3	2.00	2.280	0	5	0.425	-0.79	
Total	9.40	11.88	1	30	30.16	9.43	18	43	0.044	-2.013	

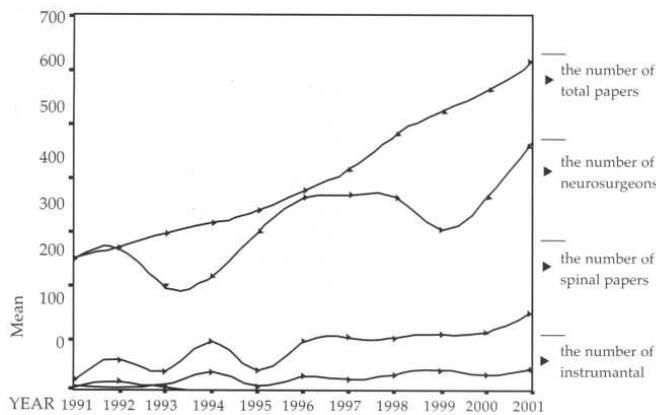


Figure 1: The diagram showing the relation between the number of different papers.

The number of spine-related papers and the number of papers on spinal instrumentation were strongly correlated after elimination of time effect (partial correlation coefficient=0.7996, p=0.005).

DISCUSSION

As mentioned above, the SSS of the TNS was founded in December 1994, but the main effects of this organizational change were seen after its first General Assembly in December 1995. The formation of the SSS led to an increase in the complexity of spinal surgery practiced by neurosurgeons in Turkey, and thus resulted in expansion of spine-related research in the years after the section was established (1996 onward). One reflection of this progress is the increased numbers of spine-related manuscripts by Turkish authors that are being published in Western neurosurgical and spinal journals. For example, in the past 3 years, 15 manuscripts and 6 letters by Turkish researchers were published in the Journal of Neurosurgery: Spine. This increase in the number of spine-related papers in Turkey is noteworthy; however, to the best of our knowledge, no statistical study has yet investigated changes in the number of spine-related papers presented at annual meetings of neurosurgeons' organizations in Turkey, the United States, or any other country.

Our study focused on categories of spine-related papers presented at 11 annual congresses of the TNS in the years 1991 to 2001. We found that a significantly higher number of spine-related studies were presented after the SSS was established. Interestingly, although the proportion of spine-related papers increased from 17.9% to 29.0% in the period covered by the study, this higher proportion is still lower than the actual proportion that spinal operations represent within all surgeries performed by neurosurgeons. It has been documented that spinal surgery accounts for 65% of all surgical procedures performed by neurosurgeons (1).

Other important results of this study relate to the various categories of spine-related research. We observed a rising trend in the numbers of papers presented in all the categories investigated; however, the only subgroups with significant increases were spinal degenerative disease, spinal tumor, spinal instrumentation, and spine-related laboratory studies. There were no statistically significant increases in the categories of spinal trauma and spinal infection. The reason for the latter may be that neurosurgeons in Turkey have always played an active role in treating these two types of disease. In most Turkish institutions, laminectomy or sublaminar wire fixation have been the surgeries of choice for spinal trauma cases. Spinal infections, and particularly spinal tuberculosis, have been treated for many years with decompression and fusion without instrumentation.

Concerning degenerative disorders, our study revealed significant increases in the numbers of papers presented on degenerative disease of the cervical spine, instrumentation related to spinal degenerative disease, and degenerative spondylolisthesis. The latter change reflects a trend among neurosurgeons to treat spondylolisthesis that may be associated with lumbar disc herniation and lumbar spinal stenosis.

With respect to both spinal tumors and degenerative conditions, we noted a significant increase in the number of papers presented on cervical and lumbar neoplastic and degenerative disease. In contrast, there were no significant changes in the proportions of thoracic spinal tumor and thoracic degenerative disease-related studies, and these numbers were lower than those for cervical and lumbar neoplastic and degenerative disease.

Our study also identifies spinal instrumentation as another area of research that has expanded. The results indicate that there has been a significant increase in the frequency of spinal reconstruction at all spinal levels.

With respect to spine-related laboratory work, it appears that establishing the SSS has prompted increased numbers of biomechanical and anatomical studies of the spine in Turkey. This reflects a need for better understanding of spinal biomechanics and anatomy among neurosurgeons.

The relationships between the number of neurosurgeons and the number of spine-related papers, and between the number of neurosurgeons and the number of spinal instrumentation-related papers are interesting. Our analysis showed that the rises in the numbers of spine-related and spinal instrumentation-related papers were not solely due to the increase in the number of neurosurgeons. We believe that the establishment of the SSS has contributed greatly to expansion of all types of spine-related research in Turkey. This special focus has also prompted the unofficial creation of Spinal Divisions (determining a surgeon responsible for spine surgery) in Neurosurgery Departments at most centers throughout the country.

In conclusion, since the SSS was founded in 1994, we have seen major increases in the number and quality of spine-related papers presented at annual meetings of the TNS. The increased interest in spinal surgery has expanded the use of instrumentation in neurosurgical spinal surgery

practice. The changes reflected in this study indicate that most Neurosurgery Departments in Turkey need to provide specialized neurosurgery training, and need to establish dedicated Spinal Surgery Divisions that can provide training for residents and neurosurgeons who wish to learn complex spine surgery.

Correspondence: Sait Naderi, M.D.

Dokuz Eylül University Hospital
Department of Neurosurgery
Inciralti, 35340
Izmir, Turkey
e-mail: snaderi@deu.edu.tr
Fax: 90-232-2788802

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