



## Essay

# History of Spinal Neurosurgery and Spine Societies



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## INTRODUCTION

Historically, spine and spinal cord surgery have been an integral part of neurosurgery. It was always a part of the neurosurgery education and practically a significant part of neurosurgeons' daily work. However, spine societies have mostly been pioneered by orthopedic spine surgeons. It's only in the last 4 decades that neurosurgeons are also forming spine societies.

The term "Neurospine" becomes more popular and used by many authors, institutions



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during the last decades, although it is not widely used in North America. There are specific reasons for its popularity: (1) It is like a combination of neurosurgery and spine surgery. Neurosurgeons widely prefer to use it. (2) It has a sense inside to remind patients that the spine is with neurological structures.

“Neurospine Surgery” is also used in the sense of a combination of “neuroscience” and “spine”. There are at least 2 journals with this theme, i.e., “*Neurospine*” and “*Journal of Neurosurgery Spine*.”<sup>1</sup>

In this paper, a brief history of spine surgery and spine-related societies is discussed. We aimed to create a global summary of neuro spine with spinal neurosurgeons’ perspectives from other parts of the world and comment on the world’s current condition.

## METHODS

We reviewed the literature on spine history in PubMed and Medline. The keyword “Neurospine” had 7,703 results, “Spine Society” 4,954 results, “Spine History” 13,039 results. We evaluated the titles, excluded historical papers about the medieval ages, paleontologic studies, archeological studies. However, we included articles involving the history of spine surgery during the last 2 centuries, papers about national and international societies. The abstracts of the remaining 237 papers were then reviewed. A total of 59 articles have been chosen as the source of this review.

We surveyed spinal neurosurgeons in different countries to learn the evolution of spinal neurosurgery and spine societies. We collected the past and current status of 30 countries (Table 1).

An additional search for spine societies on their web sites helped to review the national and international spine societies (Tables 1, 2).

## RESULTS

### 1. History of Neurospine Surgery

Before the 19th century, spine surgery has mostly been done by general surgeons, neurosurgery as a discipline formed at the beginning of the 1900s.

The first successful laminectomy was performed by Smith<sup>2</sup> in 1828 in the United States. This operation was a multilevel laminectomy for a paralyzed patient after spine trauma. Not only did the patient survive, but he regained partial function. In 1891, Hadra<sup>3</sup> described wiring of the spinous processes to treat a cervical fracture. Cushing,<sup>4</sup> in 1905, attempted to remove an intramedullary spinal cord tumor but aborted the procedure after a dorsal column myelotomy. Charles Ellsberg performed a 2-stage

operation to remove intramedullary tumors; first, a myelotomy by leaving the dura open. One week later, during the second stage, the tumor has extruded from the cord and is easily removed. In 1910, Taylor<sup>5</sup> described the hemilaminectomy technique.

Posterior lateral mass fusion was later added to Albee<sup>6</sup> and Hibbs’s technique in 1911,<sup>7</sup> which remained the standard for 5 decades. This was first utilized for instability in patients with Pott’s disease.

Dandy<sup>8</sup> described 2 cases of “loose cartilage from the intervertebral disc,” causing cauda equina syndrome in 1929. But the critical publication regarding lumbar disc herniation was that of Mixter and Barr<sup>9</sup> in 1933. They reported successful resection of the first ruptured disc herniation diagnosed preoperatively. Elsberg<sup>10</sup> described the successful decompression of lumbar spinal stenosis in 1911. Cloward<sup>11</sup> is credited with championing the posterior lumbar fusion in 1940.

In 1958, Cloward<sup>12</sup> pioneered the ventral approach to the cervical spine. With his technique, it was easy to remove the disc and fuse the level by placing a bone dowel between the vertebral bodies. Caspar popularized the anterior cervical plating system in 1989.<sup>13</sup>

Harrington<sup>14</sup> reported rods with hooks and wires for compression and distraction to treat scoliosis in 1962. Larson et al.<sup>15</sup> described an aggressive lateral approach to the spine in 1976 called the “lateral extracavitary approach”. Anterior cervical instrumentation was initiated by Bagby<sup>16</sup> in a horse using a cage, in 1988. Brantigan and Steffee<sup>17</sup> combined interbody fusion with pedicle screw/plate stabilization of the lumbar spine in 1993. The anterior lumbar interbody cage was developed and reported by Kuslich et al.<sup>18</sup> in 1992.

Yasargil<sup>19</sup> and Caspar<sup>20</sup> pioneered discectomies using the microscope in 1977. Williams has also described “microdiscectomy” in 1978.<sup>21</sup>

Wiltse et al.<sup>22</sup> described the “longitudinal separation of the sacrospinalis muscles from the multifidus and longissimus. Kambin<sup>23</sup> introduced the transforaminal approach to disc herniation in 1973. However, limitations of this technique frustrated surgeons and eventually led to the development of larger “tubular” surgery.<sup>24</sup> Foley et al.<sup>25</sup> first reported lumbar discectomies through an endoscopically visualized tube in 1997. The tubular system became popular for performing discectomies and laminectomies.<sup>24</sup> Fessler and Khoo<sup>26</sup> developed multiple subsequent operations between the 1990s to 2000s, including minimally invasive cervical foraminotomy, decompression of stenosis,<sup>27</sup> TLIF,<sup>28</sup> thoracic discectomy,<sup>29</sup> resection of intradural tumors<sup>30</sup> and correction of scoliosis.<sup>31</sup> The first widely accepted percuta-

**Table 1.** Spine societies in some countries of the world

Country	Type of society			Society name, established since, web site	No. of members
	Spine Society	Spine Section	Neurospine Society		
North and South America					
USA	X	X		Spine Section of AANS/CNS (Spine Summit), 1978, <a href="https://www.spinesection.org">https://www.spinesection.org</a>	3,300
Mexico	X	X		Spine Section of the Mexican Society of Neurological Surgery (SMCN: Sociedad Mexicana de Cirugía Neurológica), since 1998, <a href="https://smcn.mx">https://smcn.mx</a> Mexican Association of Spine Surgeons (Asociación Mexicana de Cirujanos de Columna = AMCICO), 1997, <a href="http://www.amcico.com.mx">www.amcico.com.mx</a>	148 444
Colombia		X		Spine Section of Neurosurgical Association and Spine Section of the Orthopedic Society Colombian Neurosurgical Association <a href="http://www.acncx.org">www.acncx.org</a> Colombian Society of Orthopedic <a href="http://www.sccot.org.co">www.sccot.org.co</a>	
Brazil	X	X		The Spine Department of the Brazilian Society of Neurosurgery (DCSBN), 1996 <a href="http://www.portalsbn.org">www.portalsbn.org</a> Brazilian Society of Orthopedics and Traumatology (SBOT) Spine Committee, 1986 <a href="http://www.sbot.org.br">www.sbot.org.br</a> Brazilian Spine Society (SBC), 1994, <a href="http://portalsbc.org">http://portalsbc.org</a>	> 1,000 2,000
Europe					
Germany	X	X		German Spine Society “Deutsche Wirbelsäulengesellschaft, DWG”, 2006, <a href="http://www.dwg.org">www.dwg.org</a> Section for Spine Surgery of “Deutsche Gesellschaft für Neurochirurgie,” DGNC <a href="http://www.dgnc.de">www.dgnc.de</a> Deutsche Gesellschaft für Orthopädie und Unfallchirurgie (DGOU) <a href="http://www.dgou.de">www.dgou.de</a>	1,250
Netherland	X	X		Dutch Spine Society (2002) <a href="http://www.dutchspinesociety.nl/">www.dutchspinesociety.nl/</a> Spine sections within the Neurosurgical and Orthopedic Society	
Belgium	X		X	Belgian Neurosurgical Spine Society (BNSS), 2008, <a href="http://www.bnss.be">www.bnss.be</a> Spine Society of Belgium, 2012, <a href="http://www.spinesociety.be">www.spinesociety.be</a>	
United Kingdom	X			British Association of Spinal Surgeons, <a href="https://spinesurgeons.ac.uk">https://spinesurgeons.ac.uk</a> British Scoliosis Society, <a href="http://www.britscoliosissoc.org.uk">www.britscoliosissoc.org.uk</a> Society of Back Pain Research, <a href="http://www.sbpr.info">www.sbpr.info</a> British Association of Spinal Cord Injury Specialists, <a href="http://www.bascis.org.uk">www.bascis.org.uk</a> National Back Pain-Clinical Network, <a href="http://www.joinit.org/o/national-backpain-pathway-clinical-network">www.joinit.org/o/national-backpain-pathway-clinical-network</a> Society of British Neurological Surgeons, <a href="http://www.sbns.org.uk">www.sbns.org.uk</a> British Orthopedic Association, <a href="http://www.boa.ac.uk">www.boa.ac.uk</a>	
Ireland	X			Irish Spine Society <a href="http://irishspinesociety.ie">http://irishspinesociety.ie</a>	
Switzerland	X			Swiss Spine Society <a href="http://www.spinesociety.ch">www.spinesociety.ch</a>	
Italy	X	X		Spinal Section of the National Society of Neurosurgery (SINCh = Società Italiana Neurochirurgia) <a href="http://www.sinch.it/">www.sinch.it/</a> SICV/GIS (Società Italiana Chirurgia Vertebrale/ Gruppo Italiano Scoliosi) <a href="https://www.gis-italia.org/">https://www.gis-italia.org/</a>	
Portugal	X			Portuguese Spine Society (Sociedade Portuguesa de Patologia da Coluna Vertebral) (SP-PCV), 2013, <a href="https://sppcv.org">https://sppcv.org</a> No spine sections within neurosurgical <a href="http://www.spnc.pt">http://www.spnc.pt</a> and orthopedic <a href="http://www.spot.pt">http://www.spot.pt</a> societies.	
Russia	X	X		Russian Association of Spinal Surgeons (RASS), 2009, <a href="http://www.rass.pro">www.rass.pro</a> Association of Russian Neurosurgeons - Spinal Section <a href="http://www.ruans.ru">www.ruans.ru</a>	400
Serbia	X	X		Serbian Neurosurgical Society – Spine Section <a href="http://www.snss.rs">www.snss.rs</a> Serbian Spine Society <a href="https://spineserbia.rs">https://spineserbia.rs</a>	
Bulgaria	X			Bulgarian Association of the Spine Surgeons, 2015, <a href="http://www.bassbg.org">www.bassbg.org</a> Bulgarian Society of Neurosurgery <a href="http://www.neurosurgery.bg">www.neurosurgery.bg</a>	20
Turkey	X	X		Spine Section of Turkish Neurosurgical Society, 1995, <a href="http://www.spinetr.com/eng/">http://www.spinetr.com/eng/</a> Turkish Spine Society, 1990, <a href="http://www.turkomurga.org.tr/">http://www.turkomurga.org.tr/</a>	330 388

*(Continued to the next page)*

**Table 1.** Continued

Country	Type of society			Society name, established since, web site	No. of members
	Spine Society	Spine Section	Neurospine Society		
Asia					
China	X	X		Spine sections of 2 neurosurgical societies Chinese Medical Association Neurosurgery Branch = Chinese Association of Neurological Surgery (CANS) Chinese Medical Doctors Association Neurosurgeon Branch = Chinese Congress of Neurological Surgeons (CCNS). Chinese Association of Orthopaedic Surgeons Spine Branch <a href="http://www.caos-china.org/en">http://www.caos-china.org/en</a>	
Japan	X		X	Neurospinal Society of Japan (NSJ), 1986, <a href="http://www.neurospine.jp/original53.html">http://www.neurospine.jp/original53.html</a> Japanese Society for Spine Surgery and Related Research <a href="http://www.jssr.gr.jp/english/">http://www.jssr.gr.jp/english/</a>	1,282
South Korea	X		X	Korean Spinal Neurosurgery Society (KSNS), 1987, <a href="http://www.neurospine.or.kr/eng/">http://www.neurospine.or.kr/eng/</a> Korean Society of Spine Surgery (KSSS), 1984, <a href="http://www.spine.or.kr/eng/">http://www.spine.or.kr/eng/</a>	2,125
Taiwan	X		X	Taiwan Neurosurgical Spine Society, 2001, <a href="http://www.tnss.org.tw/">http://www.tnss.org.tw/</a> Taiwan Spine Society, 1992, <a href="http://twss.org.tw/">http://twss.org.tw/</a>	473
Indonesia	X	X	X	Indonesian Neurospine Society (INSS), 2017, <a href="http://inss.or.id/">http://inss.or.id/</a> Spine Section of Indonesian Neurosurgery Society <a href="http://www.ins.or.id">www.ins.or.id</a> Indonesian Spine Society Subdivision of Indonesian Orthopaedic Association "Indonesian Orthopaedic Spine Society – Pedicle Club Indonesia" (IOSS-PCI). <a href="https://indonesia-orthopaedic.org/sub-specialties/indonesian-orthopaedic-spine-society/">https://indonesia-orthopaedic.org/sub-specialties/indonesian-orthopaedic-spine-society/</a>	
The Philippines	X			Philippine Spine Society, 1995, <a href="http://philortho.org/index/subspecialty/8">http://philortho.org/index/subspecialty/8</a>	108
India	X		X	Neuro Spinal Surgeons Association (NSSA) of India, 2001, <a href="http://www.nssa-india.com/">http://www.nssa-india.com/</a> Association of Spine Surgeons of India (ASSI), 1985, <a href="https://www.assi.in">https://www.assi.in</a> Neurological Surgeon Society of India (NSSI), 2011, <a href="http://www.nssi.in/">http://www.nssi.in/</a>	
Pakistan	X	X		Spine Section of Pakistan Society of Neurosurgeons, 1987, <a href="https://www.paksn.org/">https://www.paksn.org/</a> Society of Spine Surgeons of Pakistan, 2015, <a href="https://www.s3p.org.pk/">https://www.s3p.org.pk/</a>	
Bangladesh	X		X	Neurospine Society of Bangladesh, 2015, <a href="mailto:mhossain_ns@yahoo.com">mhossain_ns@yahoo.com</a> Bangladesh Spine Society	152
Nepal	X	X		Association of Spine Surgeons of Nepal (ASSN), 2012, <a href="http://www.noa.org.np/pages/assn">www.noa.org.np/pages/assn</a> Neuro-Spinal Chapter of Nepalese Society of Neurosurgeons (NESON), 2016, <a href="https://neson.org/">https://neson.org/</a>	
Iran			X	Neurospine Society of Iran, 2011 Neurosurgical Society of Iran, <a href="http://www.irneso.com/en">http://www.irneso.com/en</a>	
Africa					
Egypt	X	X		Spine section of Egyptian Society of Neurological Surgeons Egyptian Spine Association <a href="http://esa.org.eg/">http://esa.org.eg/</a>	
Nigeria	X			Nigerian Spine Society <a href="https://nigerianspinesociety.org">https://nigerianspinesociety.org</a> Nigerian Academy of Neurological Surgeons (NANS), 2006 Nigerian Society of Neurological Sciences (NSNS)	
Kenya				There is no spine society Neurological Society of Kenya Kenya Orthopedic Society	

neous pedicle screw system, Sextant, was reported by Foley in 2001.<sup>32</sup> Fessler and Khoo<sup>26</sup> first described minimally invasive interbody fusion and percutaneous pedicle screw placement in 2002. Foley's group has adapted the transforaminal interbody

graft and cage placement by tubes in 2005.<sup>32</sup> A minimally invasive lateral approach to the lumbar spine was initially described by Fessler and MacMillan and subsequently published by Mayer<sup>33</sup> in 1997.

**Table 2.** International and Continental Societies

Name	Foundation	Registered in, website
International Spinal Cord Society (ISCoS)	1961	Registered to United Kingdom <a href="http://www.iscos.org.uk">www.iscos.org.uk</a>
Scoliosis Research Society (SRS)	1966	Registered to USA <a href="https://www.srs.org/">https://www.srs.org/</a>
American Spinal Injury Association (ASIA)	1973	<a href="https://asia-spinalinjury.org">https://asia-spinalinjury.org</a>
Cervical Spine Research Society (CSRS)	1973	Registered to USA <a href="http://www.csrs.org/">www.csrs.org/</a>
CSRS Europe	1980	Registered to France <a href="https://csrs-europe.org">https://csrs-europe.org</a>
CSRS Asia Pacific	2010	<a href="https://csrs-ap-section.org/">https://csrs-ap-section.org/</a>
Asia Pacific Spine Society (APSS)	The APSS started with the Western Pacific Orthopaedic Association - Spine Section in 1979	Registered to Malaysia <a href="http://www.apssonline.org/">www.apssonline.org/</a>
North American Spine Society (NASS)	1985	<a href="https://www.spine.org">https://www.spine.org</a>
International Society for Minimal Intervention in Spinal Surgery (ISMISS)	1989	<a href="http://www.ismiss.com/">http://www.ismiss.com/</a>
WFNS (World Federation of Neurosurgical Societies) Spine Committee	1993	<a href="http://wfns-spine.org">http://wfns-spine.org</a>
Spine Society of Europe (SSE)	1999	Registered to Switzerland <a href="http://www.eurospine.org">www.eurospine.org</a>
World Spinal Column Society (WSCS)	It is a continuation of the World Spine Society (2003) and founded in 2008	Registered to Greece <a href="http://www.worldspinalcolumn.org">www.worldspinalcolumn.org</a>
International Society for the Advancement of Spine Surgery (ISASS)	Formerly Spine Arthroplasty Society (2000) has modified its name in 2011	<a href="http://www.isass.org">www.isass.org</a>
Asia Pacific Cervical Spine Society (APCSS)	2007	Registered to South Korea <a href="http://www.ap-css.org/">http://www.ap-css.org/</a>
Society for Minimally Invasive Spine Surgery (SMISS)	2007	<a href="http://www.societyforminimallyinvasivespinesurgery.net/">http://www.societyforminimallyinvasivespinesurgery.net/</a>
Middle East Spine Society (MESS)	2011	Registered to Egypt <a href="http://www.mespine.org">www.mespine.org</a>
Craniovertebral Junction and Spine Society	2015	<a href="http://craniovertebral.org">http://craniovertebral.org</a>
AO Spine		<a href="https://aospine.aofoundation.org">https://aospine.aofoundation.org</a>

Scoville et al.<sup>34</sup> have first described posterior cervical discectomies in 1976. A similar technique was adapted to tubular foraminotomies by Adamson<sup>35</sup> in 2001. In the 1990s, neurosurgeons were mostly performing cervical spine fixations, but orthopedic spine surgeons developed pedicle screw fixation for the thoracic and lumbar spine. Neurosurgeons took time to start using pedicle screws.<sup>36</sup>

Hepburn,<sup>37</sup> a British neurosurgeon, designed skull tongs for cervical spine traction in the middle of the 1920s for treating wounded soldiers in World War I, long before Crutchfield's publication in 1933.<sup>38</sup>

In 1910, silk sutures were used to fixate atlantoaxial instability.<sup>39</sup> Gallie first developed C1–2 wiring,<sup>40</sup> then Brooks and Jenkins<sup>41</sup> in the 1970s, then by Dickman et al.<sup>42</sup> in the 1980s. Goel described the first description of plate fixation of the lateral masses of C1 and C2 in 1994.<sup>43</sup> This technique allowed the reduction of C1 subluxation on C2. This technique was deemed safer than Magerl's transarticular screw fixation by reducing the

chance of vertebral artery injury. Goel has improved his design, did classification of basilar invagination, and achieved a posterior reduction by placing a spacer between the atlantoaxial joint. This was a paradigm shift by making a transoral odontoid resection surgery unnecessary.

Three subjects—arthroplasty, navigation, and robotics—have found great interest by neurosurgeons. Nachemson<sup>44</sup> first initiated arthroplasty in the 1950s when he injected self-hardening liquid silicone rubber into cadaver discs and demonstrated restoration of some disc properties. Spinal arthroplasty evolved slowly, and by the end of the 1990s, it became a realistic treatment. In 1966, Fernström<sup>45</sup> implanted the first artificial disc device. U.S. Food and Drug Administration (FDA) approved the first lumbar arthroplasty device in 2004.<sup>46</sup> Then, lumbar arthroplasty has decreased interest, but cervical arthroplasty gained more interest and widely used.

Navigation and robots have also improved. In 1985, the Programmable Universal Machine for Assembly 560 ([PUMA 560];

Unimation, Danbury, CT, USA) became the first-ever surgical robot used to perform a neurosurgical brain biopsy—with better-reported precision than techniques of its time.<sup>47</sup> David Roberts is credited with merging modern stereotaxis with computed tomography (CT) in 1986, setting the stage for the navigational concepts behind robotic spine surgery.<sup>48</sup> In 2004, the Spine-Assist (Mazor Robotics Ltd., Caesarea, Israel) was the first robot approved by the FDA for use in spinal surgery and remained one of the most widely used.<sup>49</sup> The SpineAssist is a shared-control robot that offers navigation superior to traditional intraoperative navigation. Although cost is a limiting factor, future generations of robots have immense potential to improve spine surgery for both patients and providers alike.<sup>50</sup>

## 2. Spine Societies in Different Countries

### 1) North and South America

#### (1) United States of America

The history of spine surgery in the USA can be considered one of the most influential accounts of the world's spine surgery.

Spine fellowship programs among neurosurgeons started in the 2000s in the USA. The pioneers of neurosurgical spine education were Edward C. Benzel, Volker Sonntag, and Charles

Stillerman.<sup>51</sup> Almost 77% of the USA's neurosurgical operations are spinal cases; it is increasing since 2013.<sup>52</sup> The *Journal of Neurosurgery: Spine* started publication 4 times a year in 1999. *Neurosurgery* and *Neurospine* have been the source of many consensus guidelines on spine surgery.<sup>37</sup>

There are many spine organizations in the USA. We considered the Cervical Spine Research Society (CSRS), North American Spine Society (NASS), and American Spinal Injury Association (ASIA) as continental organizations, and they will be mentioned below in the “International and Continental Spine Societies” section.

In 1978, Albert Rhoton suggested forming American Association of Neurological Surgeons/Congress of Neurological Surgeons (AANS/CNS) Section on Disorders of the Spine and Peripheral Nerves to Charles Drake, then President of the AANS. It is a powerful organization with 3,300 members and organizes an annual meeting called “Spine Summit” with approximately 1,100 participants (Fig. 1).

#### (2) Mexico

The Mexican Society of Neurological Surgery (SMC) was founded in 1955. It has 838 members, and the current president



**Fig. 1.** Past and current chairpersons of American Association of Neurological Surgeons/Congress of Neurological Surgeons (AANS/CNS) Spine and Peripheral Nerve Section.

is José-Antônio Soriano-Sánchez. In 1998 Humberto Mateos-Gómez and Fernando Rueda-Franco created the society sections, and the spine section was born. The current number of members is 148.

The Mexican Association of Spine Surgeons (AMCICO) was founded in 1997 by neurosurgeons and orthopedic surgeons. Only 3 of the 12 presidents have been neurosurgeons. The current number of members is 444, with almost 134 of them neurosurgeons.

In 1987, the first neurosurgical spine department was founded in the National Medical Center La Raza by José-Antônio García Rentería. There are currently 15 residency programs offering spine surgery training, of which 5 are neurosurgical.

### (3) Colombia

Spinal surgeries began in 1950, with the newly created neurosurgery services: in Bogotá at the *San Juan de Dios Hospital* of the National University of Colombia, by Dr. Alejandro Jimenez Arango, and Medellín at the *San Vicente de Paul Hospital*, by Dr. Ernesto Bustamante Zuleta. In 1960, the specialization programs officially began in Colombia. The first surgeries for scoliosis correction were performed in Bogotá by Dr. Rodriguez.

Today there are 10 postgraduate programs in neurosurgery and 2 spine fellowship programs for neurosurgeons and orthopedists. There are 500 neurosurgeons, but only 10% are dedicated exclusively to spine surgery. There are 50 orthopedic spine surgeons.

There is no spine society in Colombia, but there are spine chapters within the Colombian Association of Neurosurgery and the Colombian Orthopedic Society. In 1997, the Iberolatinoamerican Spine Society (*Sociedad Iberolatinoamericana de Columna SILACO*) was created. In 2006 the Interamerican Society of Minimally Invasive Spine Surgery (*Sociedad Interamericana de Cirugía de Columna Mínimamente Invasiva SICMI*) was formed.

In 2006, the Orthopedic Society of Colombia, under the presidency of Dr. Jorge Ramirez, created the Latin-American Center for Research and Training in Minimally Invasive Surgery (CLEMI). Only in spine surgery, more than 1,500 specialists from Latin America have been trained. From Colombia, Dr. Enrique Osorio became the president of the Spine Chapter of the Latin American Federation of Neurosurgery FLANC (2008–2010).

### (4) Brazil

Spine surgery in Brazil is organized and integrated with other major international centers. It combines knowledge between

neurosurgery and orthopedics, keeping their characteristics in the training base.

The Brazilian Society of Neurosurgery (SBN) was founded in 1957. In 1959, Prof. José Ribe Portugal participated in the World Federation of Neurosurgical Societies (WFNS), when SBN joined the Federation.

In 1970, the SBN Board of Directors established the first protocol with the bases for training and accreditation of training services for neurosurgeons, which are now over 100 training services offering scholarships for young neurosurgeons to specialize in spine surgery. Currently, SBN has approximately 2,400 members, being one of the largest societies in this specialty worldwide.

The Spine Department of the Brazilian Society of Neurosurgery (DCSBN) was founded in 1996, with Marcos Masini as the first chairman. It has more than 1,000 members. It assists SBN in organizing scientific events and answering questions from civil society or its associates.

Orthopedic surgeons founded the Brazilian Society of Orthopedics and Traumatology (SBOT) in 1935. SBOT has about 20,000 members. The SBOT Spine Committee started in 1986. The specialty has over 100 services offering one or two-year fellowship programs for spine surgery.

Brazilian Spine Society (SBC) is founded in 1994, affiliated to SBN and SBOT. SBC has around 2,000 members, holds national congresses every 2 years, and publishes the indexed journal "Coluna/Columna" regularly.

## 2) Europe

### (1) Germany

The German Spine Society (DWG) consists of spinal surgeons from neurosurgery, orthopedics, and trauma surgery. Besides, there is a section for spine surgery within the German Neurosurgery Society (DGNC).

The history of spinal neurosurgery in Germany goes with the history of general neurosurgery. The German Neurosurgery Society was founded in 1950 with 1,300 members. The society has several sections, including a spine section that organizes annual meetings.

The German Spine Society was founded in 2006 by the fusion of 2 independent German Societies, namely the German Society for Spine Research (founded in 1958) and the German Society of Spine Surgery (founded in 1987). The founding congress of the DWG took place in Munich in 2006, with 747 participants. The number of members is 1250, making it the largest spine society in Europe.

### (2) *The Netherlands*

The Netherlands has spine sections within the Neurosurgical Society and Orthopedic Society. In 2002, these spine sections fused to become the Dutch Spine Society (DSS), consisting of orthopedic surgeons and neurosurgeons. Dr. Wilco Peul was one of the founders, and after the early successful years, he organized a Spine Week in Amsterdam.

### (3) *Belgium*

The Spine Working Group, created in 2007, was transformed into the Belgian Neurosurgical Spine Society (BNSS) and approved during the 2008 Annual Meeting.<sup>53</sup>

### (4) *United Kingdom*

British spinal neurosurgery history dates back to 1887 when Sir Victor Horsley removed a spinal tumor through a laminectomy.<sup>54</sup> The Society of British Neurosurgeons was formed in 1926, making it the second-longest functioning national neurosurgical society globally. In the first 10 meetings, 18 surgical demonstrations were conducted, of which only 2 were spinal.<sup>45</sup> In the early days (1961), neurosurgical training was up to 12 years, involving a long general surgery period. It's believed that many neurosurgical departments were unable to meet the standards for training and treating spinal injuries.<sup>55</sup>

Spinal surgery in Britain has undergone significant changes, with increasing instrumentation (39%). Superior clinical outcomes helped the transition to increased instrumentation in spinal neurosurgeries.<sup>55,56</sup> The number of degenerative spinal surgeries amplified due to the aging population.<sup>57</sup>

Recently, the United Kingdom Spine Societies Board (UKSSB) composed of 6 national societies dedicated to spinal care, was introduced. UKSSB welcomes spinal surgery representatives of the British Orthopedic Association (BOA) and the SBNS. "Brit-Spine" happens on a biannual basis.<sup>58</sup>

The British Spine Registry was started in 2012, an efficient platform for recording surgical outcomes in the UK.<sup>59</sup> Currently, dedicated spinal surgery training is conducted in both orthopedic and neurosurgical specialties. Spinefellowships.com is a web-based resource providing spinal fellowship opportunities in the UK.<sup>60</sup>

### (5) *Ireland*

Adams Andrew McConnell, the first neurosurgeon in Ireland, has made essential contributions to neurosurgery, including spinal surgery. He published the first-ever account of suboccipital decompression for Chiari malformation.<sup>61</sup> In 1945,

spinal surgery in Ireland had a breakthrough due to the tuberculosis act initiation, which led to spinal care improvement.

Spinal surgery in Ireland has always had combined efforts between orthopedic and neurosurgeons. Both disciplines established the Irish Spine Society in 2016. Prof. John McCabe is the current president and is the longest-serving spinal surgeon in Ireland. Currently, of the 23 Irish spinal surgeons, only 5 are spinal neurosurgeons.

The National Spinal Injuries Unit for Ireland (founded in 1991) is located in the Mater Hospital in Dublin. The National Neurosurgical Centre for Ireland at Beaumont Hospital in Dublin is a specialized center for spinal surgical care.<sup>62</sup>

### (6) *Switzerland*

Spine care in Switzerland is based primarily on the foundation of a neurosurgical department in Zurich in 1937 by Hugo Krayenbühl.<sup>63</sup>

The Swiss Spine Society was founded in 1999 by 2 mother societies, the Swiss Neurosurgical Society and the Swiss Orthopaedics. Board committee members are equally elected from neurosurgery and orthopedic surgery, and the chair rotates every second year to reduce the natural friction of both groups.

Several healthy national spine societies, industry partners, and globally active organizations such as AOSpine and Eurospine are based in Switzerland and promote excellence in Swiss spine care.

### (7) *Italy*

In Italy, there are 2 spine-related societies:

Italian Society of Neurosurgeons SINch Spine Section: The Italian Society of Neurosurgeons was born in 1948 in Turin. The first meeting of the founding members was in 1950. In 2018, the society turned 70 years old, becoming one of Europe's most aged society, after Swedish Society (almost 100 years old) and the English Society (founded in 1926).

Italian Spine Society (SICV/GIS) was founded by orthopedic surgeons focused on spinal surgery and scoliosis surgery, but for the last 10 years, it also embraces neurosurgeons. From 2018 the Spine Section of SINch and SICV/GIS are connected and work together for scientific purposes.

In 1977 a group of Italian orthopedic surgeons interested in spinal surgery founded the Italian Group of Scoliosis Study (GIS). The first national meeting was in Pisa about "Treatment of scoliosis with corsets" in 1978. Recently, there is a conjunction with the Italian society of neurosurgeons due to neurosurgeons' progressive interest in spinal surgery to integrate knowledge and



standardize diagnosis and treatment.

#### (8) Portugal

The birth of modern neurosurgery in Portugal can be traced to the 50s, with the advent of the first Neurosurgical Department in the Iberian Peninsula, by Dr. António Vasconcelos Marques. He had a fellowship at John Hopkins and created the department in Lisbon.

The Portuguese Spine Society (SPPCV) was created in 2013 with orthopedic and neurosurgical spine surgeons and rehabilitation doctors. Currently, all neurosurgical training centers in Portugal feature training in spinal pathology.

#### (9) Russia

Russian Association of Spinal Surgeons (RASS) is the leading spine society composed of ortho and neurosurgeons with more than 400 members.

Spine surgery in Russia developed with all medical sciences. In 1929, Nikolai Nilovich Burdenko performed the first surgery on the lumbar spine and spinal roots in the National Center for Neurosurgery. During the war years, the number of spinal surgeries increased significantly in Ufa and Kazan's evacuation hospitals supervised by Egorov. The spine's systematic surgical interventions began in the post-war years with Prof. Kadin, performing disc herniation surgery. Prof. A.V. Livshits first created the All-Union Spinal Center of the Institute of Neurosurgery in the 1970s. Prof. Ivan Nikolaevich Shevelev starts the modern age of diagnostic methods and microsurgery of the spinal cord, establishing a specialized neurosurgeon's school. Prof. Theodor Petrovich Thyssen began the development of endovascular spinal neurosurgery. Since 2014, Prof. Nikolai Aleksandrovich Konovalov at the National Center for Neurosurgery in Brudenko, and a student of I.N. Shevelev has been the leader of spinal neurosurgery in Russia.

The Central Institute of Traumatology and Orthopedics named after NN. Priorov (CITO) opened a spine department by Arkady Ivanovich Kazmin in 1966. He was the first to perform operations on the vertebral bodies and intervertebral discs in scoliosis cases - wedge-shaped resection, discomy (1961), enucleation (1968). In 1988, Stepan Timofeevich Vetrile became the chairman at CITO, and he used transpedicular screws for the first time in Russia.

In St. Petersburg, spine surgery was initiated in an orthopedic institute by Prof. R.R. Vreden. In the 1920s, correction surgeries for spinal deformities were developed. Today, Prof. D.A. Ptashnikov is a leader in treating trauma and other diseases of the

spine. Prof. Yakov Leontievich Tsivyvan started developing neurosurgery in Siberia at the Novosibirsk Research Institute of Traumatology and Orthopedics (NIITO). Dr. Lutsik developed decompression and stabilization surgeries of the spine and set the doctrine of reflex pain syndromes.

In 2009, the RASS was established. The last RASS congress was held in Moscow, with over 750 participants.

#### (10) Serbia

The beginning of spinal neurosurgery in Serbia started in the first decade of the 20th century. The reference centers for spinal neurosurgery in Serbia are in Belgrade, Niš, Novi Sad, and Kragujevac. Almost all modern techniques of spine surgery are performed in Serbian centers. A clear separation between the orthopedic and neurosurgeons is most common, although an excellent collaboration is established in some centers.

Spinal injuries used to be and still are treated by orthopedic spine surgeons, mainly in the Spinal Center of the Institute for Orthopedic Surgery "Banjica." Following the world trend of neurosurgical take-over, many neurosurgeons in Serbia have switched the focus to spine surgery.

Spine Experts Group was initially founded in Serbia through the intense effort of Prof. Zdeslav Milinković, who was heading the group from the Institute for Orthopedic Surgery "Banjica."

Spine Section of Serbian Neurosurgical Society is the leading society of spinal neurosurgeons in Serbia. Spine Section, together with the Association of Neurosurgeons of Russia, RASS, Croatian Society for Spine Surgery, and Spine Experts Group, formed a joint venture WFNS Spine Committee in organizing the largest spine congress in this region in Niš in 2018.

Serbian Spine Society is a combined organization of orthopedic and neurosurgical spine surgeons. Three of the 5 executive committee members are neurosurgeons.

#### (11) Bulgaria

In Bulgaria, most spinal surgical procedures are performed by neurosurgeons, while orthopedic spine surgeons treat severe scoliotic deformities.

The Bulgarian Association of Spine Surgeons is founded in 2015 by an orthopedic surgeon, Prof. St. Stanchev. He is the first and current chairman. Founding members are neurosurgeons and orthopedic surgeons.

The Bulgarian spinal surgery history is intimately related to Bulgarian neurosurgery, which is established more than 80 years ago. Prof. Filipov is the founder of the Bulgarian Neurosurgery, who performed the first neurosurgical procedure in 1937. Sig-

nificant contributors to the Bulgarian spinal neurosurgery are L. Karagiozov, M. Vanev, V. Busarski, St. Stanchev, P. Tanchev, and N. Tivchev.

### (12) Turkey

There are mainly 4 organizations in the field of spine surgery in Turkey.<sup>64,65</sup>

Orthopedic surgeons establish the Turkish Spine Society in 1990 under the leadership of Dr. Emin Alici. Society is organizing international meetings every 2 years. In 2011, the bylaws were changed to form an executive committee from both ortho and neurosurgeons in equal amounts, and the chairman varies between both disciplines every 2 years. There are 388 members of the society (215 orthopedic surgeons, 153 neurosurgeons, 20 other fields). *Turkish Spine Journal* is the official journal.

Spine and Peripheral Nerve Section of the Turkish Neurosurgical Society were founded by Mehmet Zileli and Ali Fahir Ozer in 1995. It has more than 330 members, organizes annual symposia with the participation of 350–400 attendees. Other than yearly meetings, they organize a basic course named “summer school of the spine” and an advanced course, “Dr. Mehmet Zileli course,” which is organized since 1997.

AO Spine Turkey is a small group working as the Turkish chapter of AO Spine, containing both ortho and neuro spine surgeons.

International Society for Minimal Intervention in Spinal Surgery (ISMISS) Turkey is another small group working as the Turkish chapter of ISMISS society and organizing annual meetings. Istanbul Spine Masters is a conjoined yearly meeting of the Middle East Spine Society and ISMISS Turkey since 2015.

### 3) Asia

#### (1) China

In China, spine surgery is practiced mainly by orthopedic spine surgeons. Contributions of neurosurgeons in spine surgery are relatively new. There are spine sections in both orthopedic and neurosurgical societies.

The history of spinal neurosurgery dates back to the 1950s when Dr. Guosheng Duan began to perform spinal surgery in northeast China. However, many other neurosurgeons were focusing mainly on brain surgery. After a wide usage of CT and magnetic resonance imaging, the detection rate of brain tumors significantly increased. Hence the neurosurgeons did not spend time on the spine, and many neurosurgery departments were named “Brain Surgery Department.”

With the increase in international communications and exchange, neurosurgeons gradually realized the importance of the

spine subspecialty. The younger generation who was trained overseas started to change, including Dr. Fengzeng Jian and Dr. Hailong Feng.

In 2007, Dr. Jian published the article “Spring of Spinal Neurosurgery in China” in the Chinese Society of Neurosurgery’s official journal. In 2011, Dr. Jian served as the chairman of the spine and spinal cord section committee. He united most neurosurgeons interested in spine surgery and organized the “First Annual National Conference of Spinal Neurosurgery.” The rapid development of spinal neurosurgery began in 2013.

#### (2) Japan

The first procedure of spinal neurosurgery (the resection of cervical schwannoma) in Japan was done in 1911.<sup>66</sup> The academic predecessor of the Japan Neurosurgical Society was established in 1948. Spinal neurosurgery became gradually popular around the 1970s. In 1979, the regional study group of spinal neurosurgery, which is now called as Society for Kinki Spinal Surgery, was founded by Shuro Nishimura.

In 1986, Japan’s national study group of spinal neurosurgery, known as the Japanese Society of Spinal Surgery, was founded by Hiroshi Abe, Akira Hakuba, Satoshi Kadoya, and others. It is then renamed as Neurospinal Society of Japan (NSJ). Hiroshi Nakagawa was appointed as the first chairman of the society. A certification system for training of spinal neurosurgeons was started. In 2010, a spine committee between neurosurgery and orthopedics was also started. NSJ was finally approved as a general incorporated association of Japan in 2011. Phyoo Kim is currently the chairman of NSJ.

In Japan, the neurosurgical care emphasizing cerebrovascular disorders, brain tumors, and brain trauma has then changed to a comprehensive neurosurgical system, including spinal neurosurgery. As of 2020, there are 29 directors in NSJ, and the number of regular members has increased to 1,282, including 130 certified instructors and 472 certified spinal neurosurgeons. NSJ holds an annual meeting once a year and also forms a conference called “ASIA SPINE” with the collaboration of the Korean Spinal Neurosurgery Society (KSNS) and Taiwan Neurosurgical Spine Society (TNSS).<sup>67</sup>

The Japanese Society for Spine Surgery and Related Research was established in 1974. The society subsequently evolved into the Japanese Spine Research Society in 1985, the Japan Spine Research Society in 1990, and the current Japanese Society for Spine Surgery and Related Research in 2001. It is mainly in the hands of orthopedic spine surgeons.

### (3) South Korea

The Korean Spinal Neurosurgery Research Society (KSNRS) was established in 1987,<sup>68,69</sup> (Fig. 2). It was renamed the KSNS in 1999. The first meeting of KSNRS was held in Seoul in 1987 (Fig. 3), with 58 members by the leadership of Hwan Yung Chung.<sup>68,69</sup>

In 1996, spinal neurosurgeons from Korea and Japan, including Hiroshi Nakagawa, Young Soo Kim, and Jung Keun Suh organized the first biennial meeting of the “Japan-Korea Conference on Spinal Surgery” in Nagoya, Japan.<sup>67,70</sup>

In 2010, the Korea-Japan Conference on Spinal Surgery had evolved to “ASIA SPINE” to represent spine surgeons from across the whole of Asia. The first Asia Spine conference was held in Incheon, Korea, in 2010, with delegates from Japan, Taiwan, China, and Australia.<sup>67,70</sup> After that, ASIA SPINE meetings have been held up to the present annually, with the 10th Asia Spine held in Seoul in 2019.

At present, there are 6 subspecialty societies of KSNS, including Minimally Invasive Spine Surgery (KOMISS, established in



**Fig. 2.** Logos of the Korean Spinal Neurosurgery Society (KSNS) (A) and Neurospinal Society of Japan (NSJ) (B).



**Fig. 3.** Photo of the inaugural and the first Annual Meeting of Korean Spinal Neurosurgery Research Society (KSNRS) (the former name of KSNS) in Hanyang University Hospital, Seoul, December 19, 1987.

2002), Cervical Spine Research Society (KOCRSRS, established in 2007), Spinal Deformity Research Society (established in 2009), Spinal Research Society (established in 2010), Spinal Osteoporosis Research Society (established in 2014), and Spine Oncology Research Society (KSORS, established in 2014). All those local societies host annual meetings and are actively carrying out academic activities.<sup>68</sup>

The *Korean Journal of Spine* was first published in March 2004 as the official journal of the KSNS. The journal was renamed “*Neurospine*,” beginning with March 2018, as the official journal of ASIA SPINE, the KSNS, the NSJ, the TNSS, and WFNS.<sup>68</sup> The KSNS first published the Korean book, “The Textbook of Spine,” in 2008.<sup>68,69</sup> KSNS is the largest division of Korean Neurosurgical Society (KNS), and the total number of members is 2,125.

The Korean Society of Spine Surgery (KSSS) was founded in 1984 by orthopedic surgeons, and all chairpersons are orthopedics. It holds meetings twice a year. The affiliated journals are the “*Journal of the Korean Society of Spine Surgery*” and the “*Asian Spine Journal*.”

North Korea is a closed country with very few international cooperation. Although Korean American neurosurgeons’ efforts have resulted with some visits starting with 2008,<sup>71</sup> there is no spine society in North Korea.

#### (4) Indonesia

The first neurosurgery service in Indonesia was started by a Dutch surgeon, Lenshoek, in 1948. In 1953, 111 operations out of 277 neurosurgery operations were on the spine.

Many neurosurgeons who returned to Indonesia from the Netherland and the USA have helped in improving neurosurgery. In 1969, Prof. R.M. Padmosantjojo came and performed Cloward’s anterior cervical surgery. Until 1982, all spine operations in Indonesia were only done by neurosurgeons. Over time the Spine Committee of the Indonesian Neurosurgery Society was established. Then, the spine divisions in neurosurgical training centers developed as well. Spine Division of Neurosurgery Department of Airlangga University started a fellowship program in early 2016. The Indonesian Spine Up-Date Events have been held regularly.

In 2017, a group of neuro spine surgeons (Abdul Hafid Bajamal, Yesaya Yunus, Eko Subagio, Tjokorda G.B. Mahadewa) founded the Indonesian Neurospine Society (INSS) in Surabaya. An official journal of INSS, “*Neurologico Spinale Medico Chirurgico Journal*,” started to be published.

There is also an Indonesian Spine Society (ISS) founded by

orthopedic surgeons, of which a small number of members are neurosurgeons. There is a subdivision of the Indonesian Orthopaedic Association “Indonesian Orthopaedic Spine Society – Pedicle Club Indonesia” (IOSS-PCI).

#### (5) The Philippines

Modern neurosurgery in the Philippines began in the 1940s after World War II when United States (US)-trained neurosurgeons came back. By the 1950s, 3 neurosurgical centers were established, and by 1961, the national society of neurosurgeons was formed. Currently, there are 10 training programs in neurosurgery. The Academy of Filipino Neurosurgeons (the national organization of neurosurgeons) has a stronghold of around 140 fellows serving close to 110 million Filipinos.

There is no neuro spine society in the Philippines. They are gathered in a spine society composed of orthopedics and neurosurgeons founded in 1975. Prestigious membership to this group was by invitation only, and this eventually led to its dissolution. In 1995, the Philippine Spine Society was formed, including both orthopedic and neurological surgeons.

#### (6) Taiwan

The development of neurosurgery in Taiwan started in the 1950s. Taiwan Neurosurgical Society was officially established in 1993. Taiwan Spine Society is set in 1993 by orthopedic surgeons. TNSS is established in 2001 and currently has 473 members.<sup>72</sup>

#### (7) India

The first major meeting on the spine was held in India in 1983, at New Delhi. Dr. Ingalhalikar formed the Association of Spine Surgeons of India (ASSI) in 1985. All founding members were orthopedic spine surgeons. This is one of the first spine societies globally compared to NASS (1984) and British Spine Society (1986).

The first scientific meeting of ASSI was held in Mumbai in 1986, the so-called “ASSICON,” attended by 82 orthopedic surgeons and neurosurgeons. ASSI holds annual conferences attended by 300–400 delegates every year. At present, the association has 2,500 members.

ASSI applied to “The National Board of Examinations” to recognize “Spinal Surgery as a Subspecialty” in India. The first postcertification examination was held in 2006.

ASSI has been implementing 2-year fellowship programs, outreach programs across the country, capacity development programs, a Spine Registry, and a mobile application-based case

discussion forum. *Indian Spine Journal* is the official organ of ASSI, started publishing in 2018.

The “Neurological Society of India” is the apex body representing neuroscientists of the country. It was founded in 1951 by Chandy, Ramamurthi, and Narasimhan. The society has grown and now has 2,596 members and 665 trainees as associate members.

Neurological Surgeon Society of India (NSSI) was founded in 2011 in Jaipur. They have 350 members and organizing annual conferences. Their official journal is the *Indian Journal of Neurosurgery*.

Neuro Spinal Surgeons Association (NSSA) is an organization dedicated to propagating neuro spinal surgery knowledge and was founded at an international spine conference in Mumbai in 2001 by Dr. P.S. Ramani and Jutty Parthiban, Sushil Patkar, Prakash Modha, and Dewan. NSSA organizes annual conferences, cadaver workshops, and live surgical demonstrations. *Journal of Spinal Surgery* (JOSS) is the official journal of the association since 2014, published quarterly.

Over the last 3 decades, NSSA has been associated with various international neuro spinal surgery bodies, particularly the WFNS Spine Committee. The first consensus meeting of the WFNS Spine Committee on Cervical Spondylotic Myelopathy was held in Nagpur in 2018 (Fig. 4). Prof. P.S. Ramani is the for-

mer chairman of the WFNS Spine Committee.

#### (8) Pakistan

The history of spinal neurosurgery in Pakistan dates back to 1951 when O.V. Jooma started practicing neurosurgery at Jinnah. He first performed a thoracolumbar laminectomy for a spinal cord tumor. Inspired by his neurosurgical expertise, Dr. Qazi proceeded to the United Kingdom (UK) for neurosurgery training and returned to Lahore in 1956. Prof. Bashir Ahmad returned to Pakistan in 1963 from the UK and started a neurosurgical unit at Multan. He later established the first center of neurosurgery at Lahore General Hospital. Dr. Bhatti returned to Pakistan in 1970 and worked in Karachi. Many more surgeons have trained abroad and returned to Pakistan, but they focused their work on brain surgery. Local neurosurgery training started by the College of Physicians and surgeons with a 5-year program. Pakistan Society of Neurosurgeons was formed in 1987.

After the 2000s, neurosurgeons gradually realized the importance of the spine subspecialty in neurosurgery. After completing training in the UK and the USA, the younger generation, who were trained overseas, returned to Karachi, Lahore, and Islamabad.

In 2009, Karachi-Spine cadaver and hands-on workshops were started in collaboration with the World Spinal Column



**Fig. 4.** Nagpur Spine 2017 meeting. World Federation of Neurosurgical Societies (WFNS) Spine Committee organized the first consensus meeting on “Cervical Spondylotic Myelopathy” during Neuro Spinal Surgeons Association (NSSA) India. Upper row: Vedantham Rajshekar, Óscar Alves, Mehmet Zileli, P.S. Ramani, Ben Roitberg, Se-Hoon Kim, Shrada Maheshwari, Sumit Pawar. Lower row: Komal Prasad, Sanjay Behari, Satish Uthappa, Jutty Parthiban, Sumit Sinha, Hafid Bajamal, SS Kale.

Society (WSCS), Middle East Spine Society, and later with WFNS Spine Committee. The rapid development of spinal neurosurgery began from this platform, and nearly 20 spine workshops and symposia were held. Almost all major neurosurgery centers in Pakistan have spine services with facilities for complex spine surgery. Liaquat National Hospital is the only recognized center for training spine surgery by WFNS and WSCS. WFNS consensus meeting was held on thoracolumbar fractures along with Karachi-Spine in 2020 (Fig. 5).

Pakistan Society of Spine Surgery was founded in 2015 by orthopedic surgeons and has held various workshops to improve orthopedic trainees' understanding.

#### (9) Bangladesh

The Neurospine Society of Bangladesh was founded in 2015 by Prof. Abul Khair (president) and Dr. Mohammad Hossain (general secretary). There are 152 active members. The total number of neurosurgeons in Bangladesh is 168.

Orthopedic surgeons found the Bangladesh Spine Society. There is, however, no neurosurgeon in this society. AO Spine in Bangladesh is also working with the leadership of orthopedic surgeons.

#### (10) Nepal

Spine surgery is practiced by both neurosurgeons and orthopedic surgeons in Nepal. Many orthopedic surgeons have formal spine training, and a few of them are practicing spine exclusively. However, there are no neurosurgeons practicing spine surgery only. There are 2 spine-related societies in Nepal:

Association of Spine Surgeons of Nepal (ASSN) was established in 2012 by orthopedic surgeons. Neurosurgeons were not accepted as members, though they could participate in conferences.

Neuro-Spinal Chapter of Nepalese Society of Neurosurgeons (NESON) was established in 2016. It started to promote neurosurgeons in spinal surgery. The administrative work and membership are confined and conducted by the respective specialty.

#### (11) Iran

There is no spine society. Dr. Abolfazl Rahimizadeh founded the Neurospine Society of Iran in 2011.

#### 4) Africa

##### (1) Egypt

First trials of laminectomy were performed in Kasr Al Aini



**Fig. 5.** World Federation of Neurosurgical Societies (WFNS) Spine Committee Consensus Meeting 2020 in Peshawar, Pakistan. The Co-chairs of the Spine Committee Mehmet Zileli, Maurizio Fornari, Salman Sharif with the eminent participants.

general surgery department by late Prof. Zekry. The spine activity by neurosurgeons started with Prof. Soror (1955) at Cairo University. The Egyptian Society of Neurological Surgeons (ESNS) was founded in 1967. Prof. Boctor was appointed as president. The spine subspecialty of ESNS was created in 2006. Egyptian Neurospine group represented a natural development and maturation in ESNS.

In Egypt, spine practice is done mostly by neurosurgeons. Orthopedic spine surgeons are mostly doing deformity correction surgeries. Instrumented fusion surgery started in the 1970s with ordinary plates and screws.

In 2011, a group of orthopedic and neurosurgeons started a local spine society named it Egyptian Spine Association. Its current members are around 200 ortho and neuro spine surgeons. They used to have annual meetings, but their activities were interrupted due to local issues between ortho- and neurosurgeons.

#### (2) West and Central Africa

In West and Central Africa, surgical spinal pathology management is almost exclusively done by the neurosurgeons to decompress the spinal cord and stabilize the spine. Gradually, in each neurosurgical wards, spine subspecialists are evolving. There are no societies dedicated exclusively to spinal surgery.<sup>73,74</sup>

Pathologies of the spine are an important part of the diseases confronting the general population in all countries.<sup>75,76</sup> The frequency of compressive myelopathies and their etiologies has not been evaluated extensively in most sub-Saharan African countries. Epidemiological studies are rare.<sup>76-79</sup> Traumatic spinal injury is a major source of morbidity and mortality in the region.<sup>67</sup>

#### (3) Nigeria

Spinal neurosurgery has been practiced in University College Hospital Ibadan and Lagos University Teaching Hospital since 1966. The Nigerian Society of Neurological Sciences (NSNS), representing neurosurgeons, was established in 1966. Spinal cases treated by neurosurgeons were congenital malformations, Pott's disease, degenerative spine diseases, and spine tumors with few trauma cases.

The Nigerian Academy of Neurological Surgeons (NANS) was formed in 2006. Prof. Arigbabu was the first president. The first conference of NANS was held in 2008, followed by a cadaver course in Abuja in 2009.

The Nigerian Spine Society consisting of both neurosurgeons and orthopedic surgeons, was founded in Lagos in 2018 by Dr. Kabir Abubakar. Dr. T. Ojo chaired the first scientific conference and cadaver workshop in Lagos in 2019. There are currently 60

spinal neurosurgeons who have a membership to both NANS and the Nigerian Spine Societies. The Nigerian AO Spine was registered in 2019.

Diagnostic facilities such as magnetic resonance imaging, CT scan machines are now available in most teaching hospitals. C-arm fluoroscopy machines are available in over 30 hospitals offering spine surgeries. Using spinal implants has become routine, and minimally invasive spinal surgeries are also offered in a few centers. Spinal neurosurgeons and orthopedic spine surgeons manage many spine cases, deformities, and degenerative spine diseases.

#### (4) Kenya

Formal neurosurgery in Kenya started in 1967 with the arrival of Dr. Renato Ruberti. He pioneered the founding of the Neurological Society of Kenya (NSK), the Pan African Association of Neurological Sciences (PAANS), and the African Federation of Neurosurgical Societies (AFNS). The last quarter of the 20th century has seen the progress of neurosurgery in Kenya.<sup>80</sup>

Orthopedic surgeons have started spinal surgery after the 2nd World war.<sup>81</sup> Dr. Kirkaldy-Willis from Canada was the first orthopedic surgeon who worked at the King George Hospital. He initiated launching the Association of Surgeons of East Africa (ASEA) in 1950. The first African orthopedic surgeon conducting spinal operations was Micah Majale.<sup>82</sup>

Dr. Majale, a neurosurgeon with Prof. Renato Ruberti, can be regarded as the pioneering spinal surgeons in Kenya. They were later joined by 2 orthopedic surgeons, Mr. Suleiman and Mr. Sheikh, and the 2nd Indigenous African Orthopedic surgeon, Mr. Joab Bodo. Team of surgeons at KNH enriched with joining of J. Beecher, David Stuart, and G. Sikallieh. Beecher and Stuart developed spinal surgery at the European Hospital (now called the Nairobi Hospital) in the mid-1960s. This private Hospital catered exclusively for the white settler community residing in Kenya. This led the non-white surgeons to offer their services at the multi-ethnic Hospital developed by the Aga Khan. At the second site in Parklands, the Aga Khan Hospital opened its doors to the general public in 1959.

In the mid to late 1960s, Stuart and Ruberti developed spinal surgery for tuberculosis and lumbar laminectomy for disc prolapse and spinal stenosis. Prof. Jawahir Dar, an Indian neurosurgeon, joined the University of Nairobi in 1973.

At this time, laminectomies, spinal tumor surgery, and wiring procedures for spinal injury were being done. David Stuart introduced interbody pedicle screw stabilization in the 1980s, a technique he taught Mahmood Qureshi in 1993. Renato Ruberti

had been trained in Napoli offered anterior cervical discectomy and fusion using plates and screws.

Alberto Bencivenga, an Italian orthopedic surgeon, joined from Somalia, initiated surgeries for scoliosis. Scoliosis surgery improved until the mid-90s by visiting surgeons from the USA, then younger orthopedic surgeons could perform. Dr. Ombachi, who trained as a Spinal Fellow under Dr. Rob Dunn, and Dr. Akil Fazal, worked primarily at the KN.

Mahmood Qureshi returned from Southampton as the first holder of the specialty in neurosurgery in the region in 1992. He started the first lumbar microsurgical discectomy in 1992. He also pioneered the use of Hartshill rectangle and sublaminar wiring to stabilize the cervical, thoracic, and lumbosacral region.

A more comprehensive spinal surgery array is now available in towns like Moi Teaching and Referral Hospital with Dr. Florentius Koech. Dr. Kasmani introduced endoscopic spinal surgery in that Hospital.

Specialist training at the University of Nairobi, commencing in 2007, and the College of Surgeons of East Central and Southern Africa (COSECSA), a WFNS accredited neurosurgical training center. Regional centers can be counted as follows<sup>83</sup>: Consolata Mission Hospital in Nyeri, Coast Provincial General Hospital in Mombasa. KNH, Coptic Mission Hospital in Nairobi, and Tenwek Mission Hospital.

### 3. International and Continental Spine Societies

#### 1) *International Spinal Cord Society*

The Spinal Unit at Stoke Mandeville Hospital was founded in 1944 by Sir Ludwig Guttmann. After the World War II, it became the most important center of spinal cord injured patients fostering rehabilitation. In 1952 it became the National Spinal Injuries Center. International Stoke Mandeville Games has started the foundation of the International Medical Society of Paraplegia in 1961. Sir Ludwig Guttmann became the first president. Spinal injury assessment and initial management NICE guidelines are published in 2016 by the International Spinal Cord Society (ISCoS). Formerly “Paraplegia,” now “Spinal Cord,” is the official journal of ISCoS.

#### 2) *Scoliosis Research Society*

Scoliosis Research Society was founded in 1966 by 37 orthopedic spine surgeons, with the current number of members over 1,000.

#### 3) *American Spinal Injury Association*

ASIA was created in 1973. It is mostly a society of spinal cord

injury rehabilitation. There were also patients among the founders. The official journal is the “Topics in Spinal Cord Injury Rehabilitation” (<https://asia-spinalinjury.org/>). International Standards for Neurological Classification of SCI (ISNCSCI) Worksheet and ASIA impairment scale are the most widely used classification systems developed by ASIA.

#### 4) *Cervical Spine Research Society*

CSRS is founded in 1973 by orthopedic surgeons. The founding president is William Fielding. It organizes annual meetings. CSRS Europe (1980) and CSRS Asia Pacific (2010) are sister organizations. *Clinical Spine Surgery* is the official journal.

#### 5) *Asia Pacific Spine Society*

This is the Spine Section of the Asia Pacific Orthopedic Association (APOA), which started with the Western Pacific Orthopedic Association - Spine Section in 1979. It organizes regular meetings and courses. *Asian Spine Journal* is the official journal.

#### 6) *North American Spine Society*

NASA is established in 1984 by David Selby, William Kirkaldy-Willis, and Leon Wiltse. The same year, in 1984, another group called American College of Spinal Surgeons was created, which was allied with the American Academy of Orthopedic Surgeons (AAOS).

In 1985, by merging the NASA and the American College of Spinal Surgeons, NASS was officially formed. In those years, having 350 members, NASS reached 7,500 members in 2011. It has an official journal, “*The Spine Journal*,” and “*Seminars in Spine Surgery*.” NASS can be considered the largest spine society in the world.

#### 7) *International Society for Minimal Intervention in Spinal Surgery*

This society was founded in 1989 under the leadership of Parviz Kambin, first President of ISMISS, together with European counterparts Adam Schreiber (Zurich), Mario Brock (Berlin), Hansjoerg Leu (Zurich), and Asian pioneer Sadahisa Hiji-kata (Tokyo). ISMISS has held regular annual meetings in Zurich, Switzerland since the 1980s, and after 2015 in different countries. ISMISS also has country chapters.

#### 8) *Spine Committee of WFNS*

Founded in 1993 by Lyndsay Symon, the first chairman was Dr. Russell Hardy. Dr. P.S. Ramani chaired the committee be-



tween 2005–2013 and enlarged it to be a real multinational organization. Since 2010, the committee is organizing regular meetings every 2 years and many courses and webinars. Besides, consensus meetings and recommendations have been implemented on common spinal disorders. Prof. Mehmet Zileli is the enthusiastic force behind the success of this committee.

#### 9) *Spine Society of Europe (SSE)*

SSE was founded in 1999, and the first chairman is Carlos Villanueva. It organizes annual congresses that gather more than 1,000 participants. Society has developed a spine data registry called Spine Tango and a so-called “Eurospine Diploma” after implementing a curriculum-based course in basic, advanced, and professional levels. The official journal is the *European Spine Journal*.

#### 10) *World Spinal Column Society*

After the success of the first World Spine Congress in Berlin organized by Dr. Mario Brock in 2000, a World Spine Society was founded during the second meeting in Chicago in 2003. NASS society supported the World Spine Society but has withdrawn its support after the fourth World Spine Congress in Istanbul in 2007. The name was changed to the WSCS. The founding president is Dr. Edward C. Benzel. The last meeting (8th World Spine Congress) is organized in New Delhi in 2018. A recent successful virtual conference, “Virtual World Spine 2020,” was held with more than 10,000 participants.

#### 11) *The International Society for the Advancement of Spine Surgery (ISASS)*

The Spine Arthroplasty Society was founded in 2000 by spine surgeons and the spine industry to improve motion preservation surgery, then changed its name to ISASS in 2011. There are representatives in 78 countries and more than 3,000 members. The official scientific journal is the *International Journal of Spine Surgery*.

#### 12) *Asia Pacific Cervical Spine Society*

Asia Pacific Cervical Spine Society (APCSS) is founded in 2007 in Korea. The executive committee contains members from China, Japan, Korea, Taiwan, Indonesia, Thailand, Vietnam, India, Turkey, UAE, and Egypt.

#### 13) *Society for Minimally Invasive Spine Surgery (SMISS)*

This is a US-based society competing with ISMISS and accepted international members after 2013.

#### 14) *Middle East Spine Society (MESS)*

In 2010, the idea of establishing a regional spine society under the name of MESS was born during a neurosurgical meeting in Istanbul, and the organization was founded in 2011 and registered in Egypt. The founding president is Dr. Mehmet Zileli, and all founding members are neurological spine surgeons. It organizes regular meetings every 2 years and an annual course called Istanbul Spine Masters ([www.istspine.org](http://www.istspine.org)).

#### 15) *Craniovertebral Junction and Spine Society*

The founder is Dr. Atul Goel. It is an organizing meeting every 2 years. The official journal is the “*Journal of Craniovertebral Junction and Spine*.”

#### 16) *AO Spine*

AO Spine is based on a foundation (AO Foundation) and registered in Switzerland. It is an academic community having the support of education and research. It has divisions such as North America, South America, Europe, South Africa, the Middle East, and North Africa, and the Asia Pacific. There are also country chapters. Annual Global Spine Congress is an AO Spine activity. They also have designed an exam called AO Spine Global Diploma.

## DISCUSSION

Table 1 is a summary of the spine-related societies of some countries. Neurospine societies were established and prominent in many Asian countries (Japan, Korea, India, Indonesia, Taiwan). However, in many other countries, there are combined spine societies and spine sections of neurosurgical societies. Unfortunately, there is a lack of spine organizations in most parts of Africa.

Table 2 summarizes the international and continental spine-related societies. Their establishments go back to 50–60 years. Their impact on spine education, research, and spine-related policies are remarkable. Two of them (SSE and AO Spine) are even implementing examinations to deliver a spine diploma. Orthopedic spine surgeons establish earlier societies. However, many contemporary societies are founded by neurosurgeons. Some examples are NSSA in 2001, APCSS in 2007, WSCS in 2008, BNSS in 2008, RASS in 2009, MESS in 2011, Neurospine Society of Bangladesh in 2015, Craniovertebral Junction and Spine Society in 2015, and INSS in 2017.

## CONCLUSION

Neurosurgeons have contributed to spine surgery for over a century, but not until recently has it attracted attention as a specialty. Neurosurgeons have developed special microsurgery techniques, minimally invasive surgery, cervical approaches, and fixation procedures. Orthopedic spine surgeons' contribution towards many disorders and surgical techniques, especially spinal fixation, trauma, and deformity correction, have been pioneering. The recent trend is to use the term "Neurospine," and journals and societies with this name are increasing. It is high time that neurosurgeons should put untiring efforts to train, maintain standards, and develop spine surgery competence.

## CONFLICT OF INTEREST

The authors have nothing to disclose.

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