

## ORIGINAL ARTICLE

# The Evolution of Spine Surgery in Greece in the Second Half of the 20th Century

### Abstract

Spine Surgery began its evolution in the beginning of the 19th century in order to reach nowadays the point of being considered an important subspecialty of Neurosurgery and Orthopaedics. The purpose of this historical review is the search and evaluation of the progress in spine surgery in the second half of the 20th century. This review concerns the evolution of this field in Greece. Special references are made to the achievements of this field, to the departments that practised it, to physicians and surgeons (orthopaedic surgeons, neurosurgeons, radiologists and rheumatologists) who developed this subspecialty and to clinical and scientific work of this time period. Eventually, the progress of medicine and technology who led to the first achievements of this subspecialty are shown and also that this progress followed the development of the National Healthcare System. In Greece, with small exceptions, the new techniques emerged with a certain delay.

**Keywords:** Spine Surgery, Trauma, Deformity, Greece, historical review

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## Introduction

The purpose of this historical background is the investigation and evaluation of developments concerning spine surgery (SS) after the period of World War II until the end of the 20th century. This review concerns developments in the international arena with particular emphasis on the creation and development of the subspecialty in Greece. It is demonstrated that the basic medical and technological developments of the era created the ground on which this subspecialty was organized. Particular emphasis will be placed on the conquests of this discipline and the physicians and surgeons (orthopedic surgeons and neurosurgeons) who made an impact in the clinical and scientific work of this era.

Finally, the importance of the progress of medicine and technology that led to the successes and achievements of a particular subspecialty and adverse conditions (social and scientific) experienced specialists of this sector.

This review presents neurosurgery and orthopedic departments across Greece that dealt with SS, medical staff, and also independent spine departments. It is also necessary to present scientific and medical advents in other disciplines that have influenced this development such as Radiology and Rheumatology.

Special reference should be made to the most important scientific - literary work, with special emphasis on textbooks, PhD theses, journal articles and reports Greek and international. It is also important to make a detailed recounting of the evolution of the scientific community in Greece on the circulation magazines on the subject, activity in Medical Schools and the establishment of scientific societies and their action.

## International developments in the treatment of the diseases of the Spine

After the 1950 the substantial breakthrough that gave impetus to the surgery of the spine was a series of innovations in neighboring branches of medical technology. The most important of these relate to radiologic imaging with the invention of CT and myelography, their development which was made prior to that and it was generalized.<sup>1</sup>

Significant advances were still anesthesiology and the organization of the Intensive Care Units with the “iron lung” (ventilator) that enabled perioperative support of vital functions and thus making possible very bloody and delicate operations.<sup>2</sup>

1. Schlich *et al.*, 2007: 17-25.

2. Roussos, 2001: 13- 18.



In Great Britain during the 1950s the first attempts of correction of scoliosis with metal implants took place by Allan<sup>3</sup> in 1955 and later by Roaf.<sup>4</sup> In addition, efforts were made to strengthen the lumbar spinal fusion with internal fixation. In 1960, P. Harrington in Houston, Texas introduces the stabilization system that bears his name with the rod and posterior fusion.<sup>5</sup> This is the first spine fusion system with metallic implants that allow early mobilization of the operated patients. Similarly in Europe, in 1963, R. Roy-Camille begins using the special plates bearing his name on the spine, although he did not publicize his technique before 1970.<sup>6</sup> In the 70s, the major innovation was the use of fixation plates and pedicle screws. The use of the latter was generalized in the 1980s and used in various systems for spinal fusion.<sup>7</sup>

In 1969 Dwyer in Australia uses a fixation device designed by Sherwood which consists of hooks for compression of the vertebral body after removal of the intervertebral disc.<sup>8</sup> The system was modified and improved by the use of a rod by K. Zielke in Germany.<sup>9</sup> In 1974, in Harvard University was invented the Boston brace to hold and correct lumbar scoliosis.<sup>10</sup>

In 1976, in Mexico City, E. Luque developed the fusion system that bears his name (Luque grid) which became widespread in the 1980s.<sup>11</sup> In 1977, Magerl presented his historical biomechanical studies and he invented an external fixation device for pedicle screw stabilization outside the body. Walter Dick and independently Kluger improved this device converting it to internal fixation by shortening the screws. It should be noted that both Magerl and Dick developed their techniques by working within the AO group which had already introduced their system of fracture fixation. The first surgery with this system took place in Basel in 1982.<sup>12</sup> Also since 1982 until nowadays the classification system of King-Moe for idiopathic scoliosis prevails.<sup>13</sup>

In 1984, the introduction of the Compact Cotrel-Dubousset (CCD) by French researchers gave new impetus to the surgery of the spine and encouraged many surgeons to specialize in the treatment of deformities of the spine. This type of apparatus uses two inmates rods with screws and hooks.<sup>14</sup> That same year Max Aebi founded in Bern the first specialized in SS research department sparked a series of innovations mainly with the assistance of John Webb in Nottingham, Rae Jacobs from Kansas and Robert Mathys. Since 1987, Max Aebi, John Webb and Robert Frigg began to develop the Universal Spine System (USS) that prevailed in the 1990s.<sup>15,16</sup>

3. Olsen et al., 1969: 143-56.
4. Roaf, 1967: 226-35.
5. Harrington, 1962: 591-610.
6. Roy-Camille et al., 1970: 1447-8.
7. Schlich et al., 2007: 17-25.
8. Dwyer et al., 1969: 192-202.
9. Zielke et al., 1975: 157-74.
10. Watts et al., 1977: 87-92.
11. Ibid.
12. Schlich et al., 2007: 17-25.
13. King et al., 1983: 1302-13.
14. Cotrel et al., 1984: 489-94.
15. Schlich et al., 2007: 17-25.
16. Aebi et al., 1988: 30-43.



Regarding cervical spine, in 1978 it was Magerl and Nakanishi in Japan working independently that performed the first fracture stabilization of the dens with the use of a screw. This technique was established using tubular bolts with Kirschner wire (K-wire) and it was further developed and described by Jorg Bohler. In addition Magerl in 1979 developed a fixation plate based on the tension band principle, whose results were published later in 1991.<sup>17</sup>

17. Schlich et al., 2007: 17-25.

### Hospitals and Clinics

After the 2nd World War, a boom followed in establishing Neurosurgical clinics in Greece who worked and gave impetus to the spine surgery. The most important of these were:

- In 1951 the neurosurgery department of the “Evangelismos” Infirmary was established under V. Griponisiotis.
- In 1953 D. Oikonomou founded the first fully organized department of Neurosurgery in Athens Polyclinic. The existence of this department discontinued in 1987.
- In 1962 the Neurosurgical Department of the General Hospital of Piraeus was founded under K. Vatopoulos.
- In 1968 the Neurosurgery Department of the “Asklepieio” Infirmary was founded under A. Karakalos.
- In 1972 the first of Neurosurgery at Children Hospital “Agia Sophia” was founded under S. Comnenos. That same year Neurosurgery Departments were founded in “Agios Paulos” Hospital under A. Apostolou and in 401 General Military Hospital under C. Mavrogiorgis.
- In 1973 a Neurosurgery Department was founded at Athens General Hospital under C. Hadjidakis.
- In 1975 the Neurosurgery Department of the “Metaxas” Hospital was founded under A. Andreadis.
- In 1979 the Neurosurgery Department at “Venizelio” hospital in Heraklion Crete was founded under F. Haralambopoulos.
- In 1980 the Neurosurgery Department of the hospital of the Greek Air Force was founded under G. Tsaprounis.
- In 1983 the University Clinic of Neurosurgery of the University of Patras was founded under N. Papadakis.
- In 1984 the Neurosurgery Department of the “G. Papanikolaou” hospital in Thessalonica was founded under M. Fylaktakis.
- In 1985 the Neurosurgery Department of the Veterans’ Hospital was founded under I. Vassiloudis.
- In 1987 the Neurosurgery Department of the “Hippocratio” Hospital of Thessalonica was founded under C. Tavridis.



- In 1989 the Neurosurgery Department of the University Hospital of Larissa was founded under V. Slatinopoulos.

- In 1990 the Neurosurgery Department of the Greek Red Cross under V. Varsos.<sup>18</sup>

In the same period many orthopaedics departments were founded which were involved in the surgery of the spine. The most important of these were:

- The Spine Department of the “Agios Paulos” Hospital founded by Panagiotis Smyrnis who was succeeded by I. Valavanis and C. Zahariou. In the same hospital and as part of the University Orthopaedics Department a spine section was active under DS Korres and G. Sapkas. (Figure 1)

18. Stranjalis, 1995: 19-25.



*Figure 1. The “Agios Paulos” Hospital with 2 active Spine Surgery Departments, the most active in Greece as far as Spine Surgery is concerned.*

- The efforts in SS in the “Asklepieio” Infirmary were continued by Th Garofalidis and his successors mainly G. Michalatos, M. Dimtsas, E. Drettakis and later T. Patsiaouras.

- The Orthopaedics Department of the “Asklepieio” in the island of Leros was founded in 1951 under C. Chrysanthakis and dealt extensively with spine fusion mainly in children.

- The first Orthopaedics Department in Northern Greece in the Kilkis Hospital was founded in 1952 by K. Kamperoglou who was succeeded by A. Kavvadias and later by I. Papadopoulos. In this department spine fusions with bone grafts were performed.

- In the “Agia Sophia” Children’s Hospital the first Orthopaedic Department was founded in 1950 by J. Michael and



since 1962 under A. Kavvadias. In the same hospital the second Orthopaedics Department was founded in 1974 with a Scoliosis Unit under J. Demetriou.

- In the “Aglaia Kyriakou” Children ‘s Hospital the first Orthopaedics Department was founded in 1962 under S. Theodorou and in 1979 the Second Orthopaedics Department was founded under S. Kosmitso and later under A. Giokas. In this latter many scoliotic patients were treated surgically.

- The Children’s Hospital of Penteli was founded in 1957 as an orthopaedic hospital and since its beginning special emphasis was placed in SS under C. Chrysanthakis and later under K. Kamperoglou, N. Mariakakis, D. Dimitriadis and I. Hager. The second Orthopaedics Department was active since 1967 under A. Arzimanoglou and later under P. Smyrnis until 1975 when it was abolished. From the noteworthy is the first in Greece posterior fusion in a patient with scoliosis in 1973 by N. Giannestras with the Harrington rod technique. The hospital also has a full archive of all the patients who have been operated in SS since its foundation and a fruitful literary and scientific work as far as SS is concerned. (Figure 2)



*Figure 2. The Children ‘s Hspital of Penteli where N. Giannestras performed the first spine fusion in Greece at 1973 by means of metallic implants.*

- In the General State Hospital of Athens “G. Gennimatas” the Orthopaedics Department was founded in 1939 but it was reestablished in 1960 because of wars and movement of staff under V. Sourmelis and then E. Lampiris, P. Panagioto-poulos and A. Touliatos. In 1989 the Second Orthopaedics



Department was founded under E. Exarchou.

- The Orthopaedics Department of the "Evangelismos" Infirmary was founded in 1944 by A. Contargyris. When he stepped down in 1951, Orthopaedics became gradually the responsibility of general surgeons until 1971 when it was re-established under I. Agnandis. In 1973 the Second Orthopaedics Department was founded under D. Papadimitriou and later under N. Papavassiliou.

- In the General Hospital of Nikaia the first Orthopaedics Department of Piraeus was founded in 1961 under K. Iliopoulos. After his retirement he was succeeded by G. Tsailas and later by N. Prevezas.<sup>19</sup>

- At the "Tzanio" Hospital of Piraeus, the Orthopaedics Department was founded in 1975 under K. Arapakis and later under Vatopoulos, P. Galanis, N. Panagopoulos and P. Vryzakis.

- The Orthopaedics Department of the Hospital of "Eleusis Thriassion" was founded in 1996 under D. Polyzois and it has been active in research on scoliosis and other diseases of the spine with the initiative of T. Grivas who later became head of this Department.

- The Orthopaedics Department of the Hospital of the Greek Red Cross was established in 1985 under N. Antoniou and later under J. Maris. This department developed intense clinical and surgical activity in SS.

- At the hospital "G. Gennimatas" Thessalonica an independent Orthopaedics Department was founded in 1986 under N. Papavasileiou evolving from the Children and Orthopaedics Department and it was the second Orthopaedics Department of the University of Thessalonica.

- In 1985 the Orthopaedics Department in the "Agios Demetrios" Hospital of Thessalonica under G. Koulali which developed a keen interest in diseases of the spine.

- In 1983 the First University Department of Orthopaedic Surgery of the University of Thessalonica was founded under P. Symeonidis until 1996 when he was succeeded by I. Pournaras. They both developed intense research activity in the diseases of the spine.

- In 1980 the University Orthopaedics Department of Ioannina was founded under P. Soucacos that developed their research and surgery related to the diseases of the spine.

- In 1985 the Orthopaedics Department of the University of Patras was founded under A. Hadjipavlou initially and later by E. Lampiris who organized the Department. As a renowned surgeon of the spine in the U.S., Hadjipavlou in-

19. Varvarousis, 2001: 359-473.



spired the development of SS.

- In 1990 the University Orthopaedics Department of the University of Crete was founded under E. Dretakis and later under A. Hadjipavlou who succeeded him. Under the direction of the latter surgery of the spine flourished as far as research and clinical applications are concerned.

- In 1989 the University Orthopaedics Department at the Democritus University of Thrace in Alexandroupolis was founded under I. Germanis and in 1999 in Larisa Medical School under K. Malizos. Both Departments dealt later with SS.

- Private clinics that dealt with SS both Orthopaedics and Neurosurgical Department were established in hospitals "Ygeia" and "Athens Medical Center".<sup>20</sup>

### Scientific activity

In 1947 the first step for separation of Orthopaedics of the trunk of general surgery took place. The Scientific Society of Orthopaedic Surgery and Traumatology (HAOST) was founded under its first chairman Richardos Livathinopoulos and it began organizing the Annual National Conference of Orthopaedics presenting many announcements and educational lectures on surgery of the spine. In 1980 at the initiative of A. Kavadias, the Greek College of Orthopaedic Surgeons was founded which undertook the training of junior Orthopaedic Surgeons by means of organizing courses and conferences including the topic of SS. In 1986 the society's separate portion for diseases of the spine was founded under first chairman J. Demetriou.<sup>21</sup>

Since 1948 HAOST publishes the quarterly magazine Greek Orthopaedic Surgery and Traumatology ( international title *Acta Orthopaedica et Traumatologica Hellenica*) with great interest and many articles on diseases of the spine from its beginning. Since 1973 it began holding an annual conference on the surgery of the spine with international participation which later received the name "N. Giannestras-P. Smyrnis" and it is still organized nowadays.<sup>22</sup>

In 1987 the Greek Neurosurgical Society was founded under its first chairman D. Anagnostopoulos and it began publishing the quarter journal "Greek Neurosurgery" since 1993 and organizing the annual National Conference of Neurosurgery with a strong interest in surgery of the spine.<sup>23</sup>

The Greek Radiological Society is the official scientific and educational institution of the Greeks Radiologists. It was founded in 1933 and its purpose is to develop and promote

20. Ibid.

21. Ibid.

22. Ibid.

23. Stranjalis, 1995: 19-25.





the highest level in Radiology, exchange scientific information in all areas of imaging and related disciplines through education and research. The journal "Greek Radiology" is the official journal of the Greek Radiological Society and it publishes scientific work of the Greek Radiologists. This society through its events and magazine with many articles contributes decidedly to the spread of imaging and interventional knowledge of the spine in Greece and internationally.<sup>24</sup>

In 1960 the Greek Society for Rheumatology was founded. It is a scientific, non-profit organization and it represents the Greeks Rheumatologists. This society publishes the journal "Greek Rheumatology" continuously from 1988 with important articles for diseases of the spine.<sup>25</sup>

### Scientific work - Posts

The rich scientific activity which developed in Greece from 1950 to 2000 has nothing to envy from the International level. It consists of journal articles, textbooks, theses and papers in Greek and international conferences. The most important of these are:

1. Chapters on SS in Orthopaedic Surgery textbooks with most important those of G. Chartofylakidis<sup>26</sup> and P. Symeonidis<sup>27</sup>, and in books of Neurosurgery such as the one of P. Kazdaglis.<sup>28</sup>

2. Specialty books or monographs on SS as the ones of D. Korres<sup>29,30</sup>, G. Sapkas<sup>31</sup>, I. Valavanis<sup>32</sup>, T. Grivas<sup>33,34</sup> and A. Hadjipavlou.<sup>35</sup>

3. A large number of papers in Greek and international journals from the 1950s onwards by various authors such as P. Soucacos, DS Korres, G. Sapkas, P. Smyrnis, J. Demetriou, N, Antoniou P. Korovessis, A. Hadjipavlou, E. Dretakis, I. Valavanis, T. Garofalidis, D. Sakkas and many others.

4. Specific reference should be made to the classification of fractures of the dens of the cervical spine by D. Korres.<sup>36</sup> This is the only classification of a disease of the spine derived from a Greek physician which is acceptable and recognized in the international level.

5. In 2000 the first vertebroplasty in Greece was performed by Professor in Radiology D. Kelekis in the "Eugenidion" Hospital that actually launched the interventional Radiology of the spine in Greece by Greek Radiologists.<sup>37</sup>

6. Publications of international repute from historians of medicine with most important those by S. Marketos on the ancient history of the diseases of the spine.<sup>38-40</sup>

7. A great number of doctoral dissertations in all the Medi-

24. Baltas, 2006, 110-165.
25. Rigatos et al., 1987: 15-75.
26. Chartofylakidis, 1981: 219-66.
27. Symeonidis, 1996: 303-54.
28. Kazdaglis, 1996: 139-69.
29. Korres, 1993: 87-170.
30. Korres, 2006: 241-356.
31. Sapkas, 1997: 15-106.
32. Valavanis, 1997: 19-73.
33. Grivas, 1994: 33-116.
34. Grivas, 1995: 28-124.
35. Hadjipavlou, 2006: 85-216.
36. Korres et al., 1989: 373-6.
37. Murphy et al., 2008: 678-86.
38. Marketos et al., 1999a: 1381-7.
39. Marketos et al., 1999b: 2358-62.
40. Karaberopoulos DA. 2009, 664.



cal Schools of Greece by Orthopaedic Surgeons, Neurosurgeons, Rheumatologists, Radiologists and Rehabilitation experts.

### Conclusion

From 1950 and onwards, there has been a boom internationally regarding the surgery of the spine. Technological developments and innovations in medicine and surgery have allowed the application of metallic implants in SS for spinal fusion and replacement of its elements. In Greece these innovations were applied with the spread of Orthopaedic Surgery and Neurosurgery and the minimally invasive surgery techniques.

Simultaneously there was intense scientific and research activity by many physicians and the general Greek medical community managed to follow the mainstream international achievements with a small time delay.

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