

## Review Article

**Evolution of Neurosurgery in the Arab World and Moroccan Contribution****Abdeslam El Khamlichi**

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**Received:** 15 April 2022 / **Accepted:** 17 May 2022 / **Published online:** 23 June 2022**BACKGROUND:** Both the contribution of the Arab World in the history of neurosurgery (NS) and its recent development are not known to neurosurgeons worldwide.**OBJECTIVE AND METHODS:** The aim is to give the reader an overview of the history of NS in the Arab World, its development over the last decades and the Moroccan contribution to this development.**RESULTS:** The first scientific roots for the practice of NS were born in the Middle East. Trephination, has been practiced for thousands of years before Christ (B. C.), by Assyrians, Babylonians and Pharaohs' physicians. The oldest medical manuscripts are the Cuneiform Medical Tablets found in Mesopotamia, and Edwin Smith's Surgical Papyrus in Egypt. These first steps would become confirmed during the Middle Ages through the influence of Arab and Islamic civilization. Modern NS was introduced into the Arab World by general surgeons of the colonial medical diaspora during the first half of the last century. Thanks to the effort of the pioneers, the number of neurosurgeons would increase over a limited period of time to reach an honorable number and ratio of 3313 and 1: 128530, respectively). Today, all Arab neurosurgeons have a national society of neurosurgery and are gathered in the Pan Arab Neurosurgical Society (PANS) which publish an official journal, the Pan Arab Journal of Neurosurgery (PAJN). The Moroccan Society of NS have made a significant contribution in the recent evolution of Arab NS and its international recognition when organizing the first World Congress of Neurosurgery (Marrakech, 2005) and initiating the first regional training program for young neurosurgeons in 2002.**CONCLUSION:** The neurosurgeons from the Arab world should be proud of their immense contribution to the history of medicine and NS. Even though the introduction of modern NS has been delayed in the majority of Arab countries, the devotion and sacrifice of the pioneers have enabled them to make for the lost time over a short period of time. This has enabled Arab neurosurgeons to meet the needs of the population in their respective countries.**INTRODUCTION**

The Arab World represents a large region of the world with over 13 million square kilometers spanning the Middle East, northern, eastern and western Africa. It is made up of 22 countries with 426 million inhabitants sharing the same Arabic language, with a long tradition of Arab-Islamic culture. All these countries are united under one political organization, the Arab League, and in many other economic and cultural organizations, among them the Pan-Arab Neurosurgical Society (PANS), created in 1995 which unified the national neurosurgical societies of all Arab countries. It plays an important role in the development of Neurosurgery (NS) in the region.

The objective of this paper is to give the reader an overview of the history of neurosurgery in the Arab World from its beginning to its development over the last four decades with future projections. There are three main sources of information to the events mentioned in this manuscript. First, my personal experience as a participant in the evolution of neurosurgery in the Arab World for almost five decades. Second, I have reviewed the literature about

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the ancient history of NS in the Arab World, the birth of modern NS in the region, and the current status of NS in each Arab country. Third, I have updated some data by exchanging emails with some colleagues in different Arab countries. Finally, this paper provides an insight into the Moroccan contribution in this evolution.

**The Birth of Neurosurgery in the Arab World:**

The geography and the human history of this part of the world, known today as the Arab World, have enabled it to become a cradle of great civilizations that influenced the first steps and the walk of mankind to progress. Consequently, the review of literature related to beginning of medicine and neurosurgery shows that the first scientific roots for the practice of neurosurgery extended from this area. Without referring to the details of the significant contribution of this region to the history of medicine and neurosurgery, we will only mention here a few practices and recommendations from primitive and Middle Age doctors who have marked the beginning of medicine and NS. We will let the reader go back to the references for more details.<sup>1-11</sup>

- Trephination, which is an ancestral technique in neurosurgery, dates back to the Stone Age, as shown by archeological discoveries and anthropological studies of skulls discovered in various areas around the world. The oldest trephined skull dates back to

10,000 years BC. It was discovered in 1959 in the North Eastern area of Morocco known as Taforalt.<sup>3</sup> Trephination has been practiced for thousands of years by Assyrians and Babylonians in Mesopotamia and by Pharaohs' physicians in Egypt.

- It is also well-established that the oldest medical manuscripts were written between the second and third millennia BC, respectively by the Babylonian and the Pharaoh's physicians, respectively in Mesopotamia and Egypt. These first medical textbooks are known as the Cuneiform Medical Tablets found in Mesopotamia, and Edwin Smith Surgical Papyrus in Egypt.<sup>8,11</sup> Hammurabi's Code of Laws, including the Medical Practice Code, written in the 21st century BC, is the first written law in the history of mankind that ruled the various aspects of Babylonian life.<sup>10</sup> The part related to medical practice rules specifically the practice of surgery, sets the fees of surgeons, and also acknowledges malpractice and the rights of patients.
- These first steps in scientific and medical development would become confirmed during the Middle Ages through the influence of Arab and Islamic civilization. The advances of medicine were made possible through the legacy inherited from the civilizations mentioned above, from the translation of books written by Ancient Greek authors, and the dedication and efforts made by physicians from that era, who are still known by the excellence, quality and number of books they have written. The founding principles of neurosurgery were set up during that period of high medical standards in the Middle Ages:
  - Trephination has evolved towards craniotomy, which was described by Abu Al Qassim Az Zahrawi (Abulkassis), using a "non-sinking" drill to make multiple small holes and connect them by cutting in between them with chisels, then removing the freed bone with forceps.<sup>4,12-14</sup>
  - The importance of anatomy was highlighted and considered as a prerequisite to practice surgery, since its lack can lead to serious consequences. "The practitioner of the Medical Art should master the science of dissection in order to learn the function of the organs, their form and location. Otherwise, he would make deadly mistakes. I have seen an ignorant practitioner, operating on women for a tumor in the neck and causing a lesion of the neck arteries with hemorrhage and immediate death of the patient", wrote Abulkassis in his Medical Encyclopedia.<sup>1,12,15</sup>
  - This newly-acquired knowledge of the anatomy and physiology of the nervous system would lead to the first scientific understanding of the disease as caused by anomalies in the organs of the human body. Based on this new and

fundamental concept, many neurosurgical diseases and their symptoms would be described and treated.<sup>16,17</sup>

- During that period, the first surgical instruments were made thanks to the genius of Abulkassis. His monography includes 190 diagrams of surgical instruments, many of them being precursors of those used nowadays.<sup>1,4,12</sup>
- Beside surgical tools, other disciplines related to surgery were initiated; asepsis, and ethical aspects of surgery.
- These short reminders show that ancient physicians of the Arab World have set up the primary scientific bases to the development of Medicine and Neurosurgery. This forefront medical knowledge would later spread around the Mediterranean Sea, to be taught in European medical schools. This would help build a bridge to the development of modern medicine at the beginning of Renaissance in Europe, in the 14th-15th centuries, which would make up the bases of the beginning of modern neurosurgery.

#### Introduction of Modern Neurosurgery in the Arab World:

Modern neurosurgery has developed gradually in Europe and North America during the first half of the 20th century, thanks to the knowledge acquired in neuroanatomy and neurophysiology, alongside the advances made in imaging, asepsis, anesthesia and the discovery of antibiotics. During that time, the Arab World had entirely been colonized, and modern neurosurgery would be introduced by general surgeons of the colonial medical diaspora. However, none of the articles we have read regarding the history of neurosurgery in the various Arab countries in the Middle East, <sup>4,18-30</sup> mentions this period relating to the beginning of modern neurosurgery in their respective countries, probably because of a lack of written references pertaining to that period.

In Morocco, since the first decade of the French and Spanish Protectorate that lasted for 44 years (1912-1956), the French physicians began to establish the modern bases of the Moroccan healthcare system and started publishing a medical journal since 1920, "Maroc Médical" (**Fig. 1**). The journal is still published, after being taken over by the first Moroccan physicians after the independence of the country. It remains an excellent reference with regards the history of medicine in Morocco and North Africa in the 20th century. The first articles related to infectious neurosurgical pathologies were published since 1929.<sup>31</sup> Later, between 1930 and 1950, other articles were published dealing with trauma, tumors, dysraphism, and neurovascular pathologies.<sup>32-34</sup>

The first papers related to functional neurosurgery were published since 1950.<sup>35-37</sup> The first issues of the journal entirely dedicated to neurosurgery date back to 1957 and 1960 (**Fig. 2A, B**).<sup>1,38</sup>

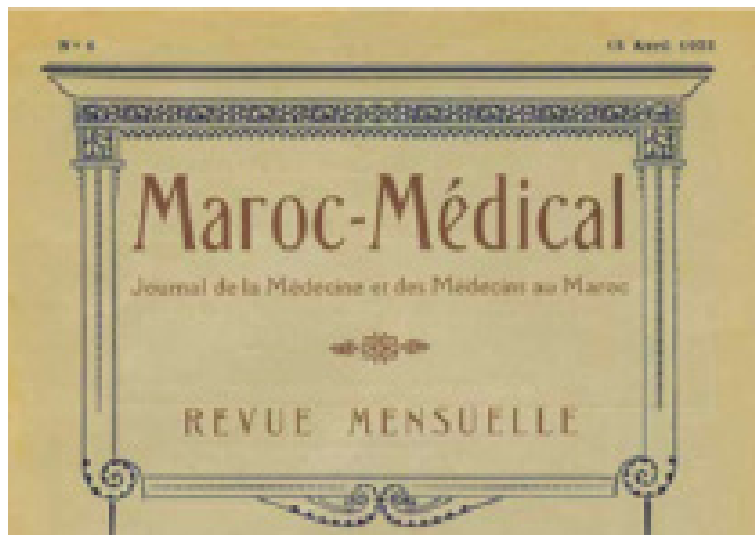


Fig 1: Cover page of the magazine Maroc Medical, a copy dating back to 1922.

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Fig 2A: First issue of Maroc Medical dedicated to Neurosurgery (1957).

NEURO-CHIRURGIE		
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Fig 2B: Second issue of Maroc Medical dedicated to Neurosurgery (1960).

Neurosurgery as a specialty carried out independently from general surgery in dedicated units or departments, began in the majority of Arab countries by the beginning of the second half of the twentieth century. In the Maghreb countries, the first units of neurosurgery were set up in Algiers, Algeria, in 1942 and in Casablanca, Morocco, in 1948, respectively by Doctors P. Goinard and A. Masseboeuf. Both were French neurosurgeons. These two units would become departments in 1954 in Algiers and in 1960 in Casablanca. The first local neurosurgeons in the Maghreb Countries would take over between 1960 and 1970: those are Doctors A. H. Kerdoudi, D. Bouchareb, M. Sami and A. El Ouarzazi in Morocco; M. Abada, I. Galli, A. Bousalah and Boutmene in Algeria; and M. Bettayeb in Tunisia. The latter set up the first operational department of neurosurgery in Tunisia in 1964.

In the Arab countries of the Middle East, neurosurgery as a specialty began early in the 1950-70. In Egypt, the pioneers were Doctors A. Abu Zikri, O. Sorour, S. Boctor, E. Tawfik, I. Hegazi and A. El Banhawi. The first department of neurosurgery was set up in the country in 1956.<sup>20</sup> In Sudan, Doctor H.S. Abu Salih was the first Sudanese neurosurgeon to chair the section of neurosurgery in the Department of General Surgery in Khartoum People's Hospital in 1971.<sup>4</sup> In Lebanon, two pioneers established the two first departments of NS in Beirut, Doctor F. Haddad in 1955 and Doctor G. Mohasseb in 1961.<sup>21,22</sup> In Syria, the first department of NS started in 1969, under the chairmanship of Doctor H. Baghdash.<sup>4,26</sup> Doctor Antone Tarazi, a Palestinian neurosurgeon, has pioneered modern NS in his country, where he established the first department of NS at Augusta Victoria Hospital in Jerusalem in 1960. For almost ten years, he kept traveling between his hospital in Jerusalem and the Main Military Central Hospital in Amman, Jordan, where he performed brain and spinal surgery. Doctor Tarazi carried the load of NS in both countries until Doctor I. Maraka came back from England after having finished his training, and ended up establishing the first service of NS in Jordan in 1970.<sup>18,23,26,27</sup> In Iraq, Doctors N. Al Yaakubi and S.H.

Alwitri are considered as the pioneers of NS. The latter set up the first department of neurosurgery in Baghdad, in 1970-72. He is considered as "the father" of NS in Iraq.<sup>4,28</sup>

In the other Arab countries, neurosurgery as a specialty was introduced gradually since the 1980s-90s. There are many pioneers to these developments: Doctors K. Al Moutaery and Z. Jamjoom in Saudi Arabia, M. Al Mahdi and A. Ramadan in Kuwait, A. Abdul Razzaq and M. Sha'aban in the United Arab Emirates, R. Sharma and A. Mashani in Oman, and A. Al Kamali and N. Al Alasbahi in Yemen.

Even if modern neurosurgery is only three to six decades old in most Arab countries, it developed quite quickly. In this way, most Arab countries would purchase CT-scan and MRI devices, and invest in building modern hospitals and neurosciences departments. Meanwhile, all the above-mentioned pioneers have established national training programs for young physicians wishing to specialize in neurosurgery, in the first neurosurgery departments they had set up.

**Table 1: Current number of neurosurgeons in Arab countries**

My deep thanks go to Doctors B. Abdennebi, A. Abukar, K. Alqadasi, T. Al-Derazi, A. Al-Mashani, M. Al-Olama, A. Al-Waer, S.A.A. Darrag, M. Darwazeh, N. El-Ghandour, H. Jemel, I. Kanaan, S.M. Salihi, I. Sbeih, for their help in updating the figures of this table

COUNTRY	POPULATION IN MILLIONS	NUMBER OF NEUROSURGEONS	RATIO
ALGERIA	44.5	580	1:76.724
BAHRAIN	1.54	11	1:40.272
EGYPT	95	850	1:111.764
IRAQ	40.22	207	1:194299
JORDAN	9	78	1:115.384
KSA	34.81	651	1:53.471
KUWAIT	3.5	17	1:205.882
LEBANON	7	110	1:63636
LIBYA	6.87	34	1:200.000
MAURITANIA	4	11	1:363.636
MOROCCO	37	300	1:148.000
OMAN	4.49	26	1:172.692
PALESTINE	5.2	45	1:115.555
QATAR	2.8	13	1:215.384
SOMALIA	16	3	1:5.333.333
SUDAN	45	65	1:692.307
SYRIA	19	150	1:126666
TUNISIA	12	100	1:120.000
UAE	9.89	10	1:989.000
YEMEN	28	52	1:538.461
TOTAL	425.82	3313	1:128530

It should be added that a significant number of Arab neurosurgeons have fled their countries for personal or social and political reasons and that they currently live in the USA, Europe, or in other continents.

This increase in numbers has gone hand in hand with great technical and scientific advances. Today, in all

The increase in the number of departments and training programs would allow the majority of Arab countries to meet the needs of their respective countries over a very short period of time. Another element has contributed to the fast evolution of neurosurgery in Arab countries the creation of the Middle East Neurosurgical Society (MENS), founded in 1958 in Beirut, by two pioneers, F. Haddad (Lebanon) and O. Sorour (Egypt), joined by the representatives of neurosurgeons from other Middle East countries (Iran, Pakistan, India, Greece).<sup>29</sup> By organizing a yearly international meeting, the MENS played a crucial role in opening Middle East countries to modern NS and bringing Arab neurosurgeons forward to international neurosurgical activity.

#### Current State of Neurosurgery in the Arab World:

Thanks to this effort of training young doctors, the number of neurosurgeons would increase over a limited period of time to reach an honorable number of 3313 neurosurgeons and a ratio of 1 neurosurgeon to 128530 inhabitants (**Table 1**).

Arab countries, NS is separated from general surgery and practiced as an independent specialty. In each major city, there are one or more NS departments led by competent professors, who maintain an international standard level of neurosurgical practice, surrounded by young people in training, with a rigorous practical and theoretical program. International exchange is very active, which

has enabled most of these departments to set up advanced subspecialties such as vascular surgery, skull base surgery, neuro-oncology, pediatric surgery, functional NS, radiosurgery and endoscopy. The same can be applied to basic biomedical equipment, whether they be imaging devices, operating theaters or modern hospital infrastructures, which are available in all departments apart from a few Arab countries, where war and social unrest can still be witnessed.

Regarding organization, there is currently a national society of NS in each Arab country. The oldest was created in Egypt in 1967. All these national societies are member societies of the World Federation of Neurological Societies (WFNS). On Dec 10, 1995, during a meeting of a working group representing the different Arab countries in Riyadh, Saudi Arabia, organized by late Doctor K. Al Moutaery, the Pan Arab Neurosurgical Society (PANS) was created, as a society gathering all neurosurgeons in the Arab World. K. Al Moutaery was the first elected president of the PANS, and organized its first Congress in 1996, in Riyadh.

The advent and acceptance of the PANS as a regional society and as a WFNS member society two years after its creation, would make Arab neurosurgery emerge as a regional body at the international level, and would be better regarded by its fellow societies. Since its creation, the PANS has organized a congress every two years (Riyadh 1996, Cairo 1998, Beirut 2000, Fez 2002, Amman 2004, Damascus 2006, Riyadh 2008, Algiers 2010, Kuwait 2012, Dubai 2014, Cairo 2016, Marrakech 2018). The last congress, scheduled in Muscat, Oman in 2020, has been postponed and has still not taken place due to the Covid-19 pandemic. It is scheduled to be organized in person on 5-7 August, 2022 in Salalah, Sultanate of Oman under the presidency of our colleague A. Al Mashani. With these regional and international congresses, and a rotating presidency between neurosurgeons from different Arab countries, the PANS has certainly given a better regional visibility to NS in the Arab World. Thanks to the efforts and dedication of late K. Al Moutaery, the PANS began, since its inception, to publish its official scientific journal, the Pan Arab Journal of Neurosurgery (PAJN). For over two decades, the PAJN has been the scientific forum not only for PANS members, but also for neurosurgeons from other countries, and the international reference on neurosurgical pathologies in the Arab world. The journal continues to be published thanks to the devotion of our colleague, Nasser El-Ghandour, its current Editor In-Chief.

Therefore, the Arab World quickly answered its needs in terms of neurosurgeons needed to meet the requirements for its population, set up NS services, for the most part well equipped and practicing high standard NS, and managed to gather up its neurosurgical community into national and regional societies. However, there is still an issue to be met by neurosurgeons in the Arab World, namely research and publication both in NS and in medicine in general. The contribution of the Arab world

in the world neurosurgical literature remains below 1%,<sup>6,30,39</sup> whereas it represents respectively 6% and 6.63% of the population and the number of neurosurgeons all over the world. Another important aspect should also be taken into consideration by training Arab neurosurgeons, namely the opening of their departments a little more to young female neurosurgeons to train in NS.<sup>40,41</sup>

### **Moroccan Contribution to the Evolution of Neurosurgery in the Arab World:**

The history of the beginning of modern NS in Morocco during the first half of the 20<sup>th</sup> century, is known today, through the preservation of medical journals of that time, whose publication began since 1920 and that currently make up a reference that cannot be replaced with regards to the history of medicine and NS in Morocco. These authentic historical roots have contributed to a better understanding of how important this specialty is in the country, and have helped separate it earlier from general surgery in the 1960s, and to be included in the country's Public Health program among the specialties with priority, and to set up a training program in neurosurgery quite early on (1964-1968). From the 1970s, Moroccan neurosurgeons were able to play a major role at the regional level and participate as founding members, in the creation of the PAANS (Pan African Association of Neurological Sciences), and in the PASNS (Pan Arab Society of Neurological Sciences) beginning in the 1970s.

Since the 1980s-90s, Moroccan NS would gather up into an original organization that would allow them to make great scientific and technological advances and to have an exceptional international aura. Consequently, Moroccan neurosurgeons would not limit themselves to creating a national society of neurosurgery, namely the Moroccan Society of Neurosurgery (SMNC) in 1984, but they would also strengthen their society by the creation of a Foundation, namely "Hassan II Foundation for the Prevention and Cure of Nervous System Diseases", in 1989. Recognized as an essential public-utility and supported by the Moroccan authorities who were aware of the limited means of the country to advance such an expensive specialty, the Foundation had an exceptional impact on the development of neurosurgery. Thanks to the funds it provided, we succeeded in overcoming the inadequacies of the state budget, which helped purchase new technologies and helped establish an annual continuing education program for young neurosurgeons.

The SMNC would then target the exchanges at the regional and international levels. We have particularly aimed Arab and African countries to share with them the originality in the development of Moroccan NS and to discuss the need for the creation of a Pan Arab regional organization of NS and an African continental organization of NS. At the time (1990-95), the PASNS (Pan Arab Society of Neurological Sciences) was chaired by A. Al Kordy (Neurologist from Jordan). He was a charismatic person who was reluctant to see Arab neurosurgeons found an independent organization of neurosurgeons. I discussed

the issue with one of the great masters of modern Arab NS, late S. Al Guindi, during the European-Arab Course of NS (Rabat, March 9-13, 1990). El Guindi was favorable to the project, but he proposed to deal with it using a lot of diplomacy so as not to offend the neurologists. He undertook to try and convince A. Al Kordy. The project would be discussed several times between the pioneers of Modern Arab NS each time we met in an international congress. I personally attended two preparatory meetings for the project, the first at the World Congress in Mexico (Acapulco, Oct 17-22, 1993) and a second one at the European NS Congress (Berlin, May 7-12, 1995). It was during this second meeting that many colleagues from Arab countries, who were disappointed by the failure of the first bid for Marrakech to organize the 2001 World Congress, agreed to accelerate the process of creating the Pan Arab Neurosurgical Society (PANS). This was to be done seven months later, on Dec. 10, 1995, in Riyadh, Saudi Arabia, during a meeting organized by K. Al Moutaery, as mentioned above. Meanwhile, the Arab neurosurgeons of the Maghrebian countries had already created the Maghrebian Federation of NS Societies, (Founding Congress in Rabat, Nov 9-14, 1994).

The SMNC came back again, and submitted the bid of Marrakech to organize the XIIIth World Congress of Neurosurgery in 2005. The success of this second bid after the vote of the WFNS Executive Committee during the AANS Meeting in San Francisco (April 9<sup>th</sup>, 2000), would make neurosurgeons from the Arab World and Africa so proud by giving them the opportunity to witness the first World Congress of Neurosurgery organized in their region. The organization of this congress in Marrakech (June 19-24, 2005), one of the cultural capitals of the Arab World, and the events that went along with (Royal Patronage, celebration of the 50th anniversary of the WFNS, the scientific and social programs), enabled participants to discover both NS and Arab and African culture and traditions. The signing of a cooperation agreement between the WFNS and Mohammed V University of Rabat helped set up the first WFNS regional training center, the WFNS-Rabat Reference Center for training African neurosurgeons (WFNS-RTC). The advent of this project has created an unprecedented enthusiasm to train young people, both in Africa and the Arab world. This would later have a very positive impact on the evolution of NS in these regions during the first two decades of the 21st century.<sup>2,42</sup>

The World Congress of NS in Marrakech has certainly contributed to the emancipation of NS in the Arab World and Africa. Following this, a sustained effort was maintained by the PANS and the national NS societies of the various Arab countries to promote NS in their countries and to allow neurosurgeons from the region to emerge at the international level. Therefore, over the past 2 decades, two Arab neurosurgeons have been elected Honorary Presidents of the WFNS, S. Al Guindi (Egypt) in 1997, and A. El Khamlichi (Morocco) in 2011. Three others received the WFNS Medal of Honour, K. Al Moutaery (Saudi Arabia) in 2009, A. El

Azhari (Morocco) in 2017 and A. Ammar (Saudi Arabia), in 2022. During the election of the current WFNS Officers (Sep 11-12, 2021), Najia El Abbadi, Moroccan neurosurgeon and current President of the PANS, was elected WFNS President-Elect. In 2023, she is going to be the first Arab and African female to hold the position of WFNS President in the history of the WFNS since its creation in 1955. Coincidentally, Nasser El-Ghandour, current President of the Egyptian Society of Neurological Surgeons (ESNS) was elected WFNS Treasurer. Many other colleagues were offered to be members or chairmen in different WFNS Committees. These positions held by Arab neurosurgeons in the WFNS leadership will certainly have a very positive impact on the future of NS in the Arab World.

## CONCLUSION

The neurosurgeons from the Arab world should be proud of their immense contribution to the history of medicine and NS. Even though the introduction of modern NS has been delayed in the majority of Arab countries, the devotion and sacrifice of the pioneers have enabled them to make for the lost time over a short period of time. This has enabled Arab neurosurgeons to meet the needs of the population in their respective countries. In order to allow Arab Neurosurgery to reach a satisfying level of development, the young generations should perfect the training systems, and make them expand, so that more female neurosurgeons are trained, and also in order to include research in clinical activities, and increase the quality and number of published articles.

## List of abbreviations

AANS: American Association of Neurological Surgeons.  
 BC: Before Christ.  
 CT: Computerized tomography.  
 ESNS: Egyptian Society of Neurological Surgeons.  
 MENS: Middle East Neurosurgical Society.  
 MRI: Magnetic resonance imaging.  
 NS: Neurosurgery.  
 PAANS: Panafrican Association of Neurological Sciences.  
 PAJN: Pan Arab Journal of Neurosurgery.  
 PANS: Pan Arab Neurosurgical Society.  
 PASNS: Pan Arab Society of Neurological Sciences.  
 RTC: Rabat Reference Center for training African neurosurgeons.  
 SMNC: Moroccan Society of Neurosurgery.  
 WFNS: World Federation of Neurosurgical Societies.  
 MENS: Middle East Neurosurgical Society.  
 SMNC: Moroccan Society of Neurosurgery.  
 NS: Neurosurgery.  
 PANS: Pan Arab Neurosurgical Society.  
 PJNS: Pan Arab Journal of Neurosurgery.  
 PASNS : Pan Arab Society of Neurological Sciences.  
 WFNS: World Federation of Neurosurgical Society.

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