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History of neurosurgery and neurosurgical applications in Turkey

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Abstract Although there is evidence of applications of cranial surgery in ancient times, it is commonly accepted that modern surgery started in the late 19th century. The advancements in anesthesiology and aseptic techniques were the main factors contributing to this process. Surgery of the nervous system, however, has a relatively shorter history than surgery of other systems. The process of surgical development in Turkey did not differ from most Western countries. Modern surgery started in 1890 in Turkey. In the beginning, neurosurgical applications were performed by general surgeons. Most of these applications included procedures for craniocerebral traumas and infections and procedures for pain relief. The first neurosurgeon, Dr Tuner, started working in 1923, operating in some spinal cord and brain tumor and trigeminal neuralgia cases. Other neurosurgeons, Dr Dilek, Dr Baydur, and Dr Kankat, were trained in France and started to work in the mid 1930s. The first neurosurgery department was established in Istanbul in 1923, and the first neurosurgery training program started in the late 1940s. Today, there are more than 50 neurosurgery training centers and more than 500 neurosurgeons in Turkey. There is an increasing number of publications by Turkish neurosurgeons, contributing to the total body of literature in neurosurgery. The current state of neurosurgery in Turkey is parallel to that of the advanced Western countries.

Keywords: History; Neurosurgery; Turkey

1. Introduction

The contemporary Republic of Turkey is located at the junction of Europe and Asia. Anatolia, the Asian part of Turkey (also known as Asia Minor), is one of the oldest parts of the world, which humankind either selected as a home or crossed on the way to the west (Europe), the east (Asia), and the south (Middle East and Africa). Anatolia was the main theater of countless immigrations, invasions, and occupations from the prehistoric ages to even the present day. This led to a concentration of influences of a variety of civilizations and cultures. Thus, all the civilizations in and around Anatolia influenced the formation of medicine and surgery in the premodern era.

The modern era of surgery started in the 19th century. The developments in modern anesthesiology and the use of antisepsis and asepsis techniques were among the main factors contributing to this process. Although this process had more important impacts on the development of some surgical disciplines, its impact remained relatively limited in neurological surgery. Therefore, surgery of the nervous system has a relatively shorter history than the surgery for other systems. This is, in part, because of the complex aspect of this discipline and the unique feature of the development of medical sciences in different countries.

Neurosurgery in Turkey started in the first half of the 20th century. However, the earlier application of neurosurgical techniques was started in the late 19th century by general surgeons. Further neurosurgical applications were also performed by general surgeons and ear, nose, and throat surgeons of the first half of the 20th century, even after formation of a neurosurgical organization [2,3,5,6,8,11-15,17,18]. On the other hand, a review of literature reveals some reports of neurosurgical applications before the modern era [4,7,10].

The aim of this study was to review the history of neurosurgery and neurosurgical applications in Turkey. However, because understanding the history of neurosurgery

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in Turkey requires a knowledge regarding the history of Turkey, a brief review of the previous and latter civilizations of this geographic region will be given.

2. Brief history of Turkey and other Anatolian civilizations

The Republic of Turkey was established in 1923. It can be accepted as the natural continuation of the previous civilizations established in the same or even larger geographic areas, including Seljuks (AD 1071-1300) and Ottoman empires (AD 1299-1923). On the other hand, there were many civilizations before the Seljuks and after Neolithic, Bronze, and Iron ages in Anatolia, including Hatti civilization (2500-2000 BC); Troy-II settlement (2500-2000 BC); Hatti and Hittite principalities period (2000-1750 BC); Great Hittite Kingdom (1750-1200 BC); Hurri civilization to Troy-VI civilization (1800-1275 BC); Aegean migration and invasion from Balkans (1200 BC); the Anatolian principalities during the Iron Age (1200-700 BC); Urartu civilization (900-600 BC); the civilization of Phrygia (750-300 BC); Lydia, Caria, and Lycia civilizations (700-300 BC); Ion civilization (1050-300 BC); Persian conquest (545-333 BC); Hellenistic and Roman ages (333 BC-AD 395); and the Byzantine civilization (AD 330-1453) [1].

The aforementioned historical background has been the main contributing factor connecting the past and the present.

3. Neurosurgical applications before Seljuks and Ottomans

There is evidence of the practice of surgery and trepanation in Anatolia since the Neolithic Age. Most of these cases dated to Bronze and Iron ages. The skulls were trepanned in more than 35 cases using 4 main techniques, including curettage, grooving, cutting, and drilling. There was evidence of healing in 19 of these cases, suggesting survival of the individuals after trepanation (Fig. 1).

One of most important examples of cranial surgery throughout the world is the discovered skull of a person who underwent craniotomy in the Urartu Age (800 BC) in Dilkaya-Van in eastern Anatolia [6]. The surgical technique used in this person seems highly developed, very similar to that used today. A free flap craniotomy was performed about 11 × 6 cm in diameter. Several small holes were connected probably with a fine chisel. Apparently, the bone flap was replaced after the procedure because both the cranium and bone flap were found together in the same grave during excavation (Fig. 2). Paleopathologically macroscopic and microscopic examination findings along the craniotomy edges suggested that this person survived after the procedure for several weeks. Another interesting finding in this cranium was the presence of a long linear fracture–looking fissure traveling from the frontal to the occipital bone. The fracture line crossed more than one branch of the middle meningeal artery. Speculation can be made about the possibility of a surgically evacuated epidural hematoma through the craniotomy. Evidence of survival after this procedure strengthens the possibility of curative surgery [6,7].

Fig. 1. The appearance of trepanation (with permission of *Turkish Journal of Neurosurgery*).

On the other hand, there are reports of the use of cauterization in the treatment of hydrocephalus, epilepsy, sciatica, and low back pain. In addition, the use of a reduction device to reduce spinal dislocations was recorded by physicians of ancient times in Anatolia. The medical doctrines of the Greco-Romans and the Syrians were transferred to Arabic by the translation of the classic treatises. This helped to prevent loss of the classics in the Dark Ages. The translation of the ancient classics was the most important factor contributing to scientific progression in the Islamic countries during the Dark Ages. After the Dark Ages, the classics were translated again into Latin.

4. Seljuks Empire

Anatolian Seljuks were the continuation of the Great Seljuks Empire. Both Seljuks and Ottomans used Islamic medical doctrines derived basically from Greco-Roman and Islamic scientists such as Hippocrates, Galen, Paulus of Aeginata, Avicenna, Rhases, and Al-Zahrawi. There is not enough data regarding the practice of surgery during the Seljuks Empire. However, it is of note that the Gevher Nesibe Hospital of Kayseri was one of the first organized hospitals in the world. Its department of psychiatry was one of the contemporary and frontier centers on neuropsychiatry (Fig. 3). There were also many hospitals in different Seljuks Empire cities (eg, Edirne, Çankırı, Kastamonu, and Amasya) in which physicians trained students, using the traditional master-apprentice system [20,21].

It is of importance to state that the snake was the symbol of medicine in Seljuks Hospital. The Çankırı Hospital's symbol was 2 snakes interwoven, and the Kastamonu

Fig. 2. The appearance of trepanation after placement of bone flap (with permission of *Turkish Journal of Neurosurgery*).

Hospital's symbol was single and had 3 curves. The Seljuks gave a great importance to the health organization of the army. In fact, the army of Melikşah had a mobile hospital carried on 40 camels. Many surgeons worked in the hospitals mentioned previously [19]; however, there is insufficient information regarding their practice.

5. Ottoman Empire

The medicine of the Ottoman Empire was a continuation of Seljuk medicine. It is a medicine that began to be influenced by Western medicine in the 15th century but remained at the limits of Muslim medicine until the 19th century when it completely turned to the West. There was no interval between the medicines of the Seljuks and the Ottomans. Seljuks hospitals remained the same. During their prosperous period, the Ottomans built many hospitals in many cities, including Bursa (1399), Istanbul (1470), Edirne (1488), and Manisa (1539) [20].

Except for a few cases of the practice of trepanation during the Ottoman period, there is no study regarding the extensive use of this technique in that age. The main aspect of medicine during this age was its Islamic-medieval characteristics. The Turkish-Islamic tradition of medicine advanced during the Ottoman period. One of the notable examples of medicine and surgery practice during this time is Şerefeddin Sabuncuoğlu. This Turkish physician wrote many medical treatises, including a colored illustrated surgery treatise, *Cerrahiyetül Haniye* [*Imperial Surgery*], in the 15th century. This surgery atlas contains much surgical information and many figures. The text portion of the treatise was written in Turkish and was very similar to *At-tasnif*, a surgery treatise written by Al-Zahrawy, a famous medieval Arabian surgeon of Cordoba. The figures were, however, original. This atlas contains depictions showing many neurosurgical applications for epilepsy, hydrocephalus, headache, low back pain, sciatica, and spinal dislocations (Figs. 4 and 5). The main techniques described and illustrated in this atlas were cauterization techniques [4,10]. Similar techniques were used until the first half of the 19th century. It is of significance that Sabuncuoğlu referred to Paulus of Aeginata, suggesting that Ottoman physicians were aware of ancient treatises.

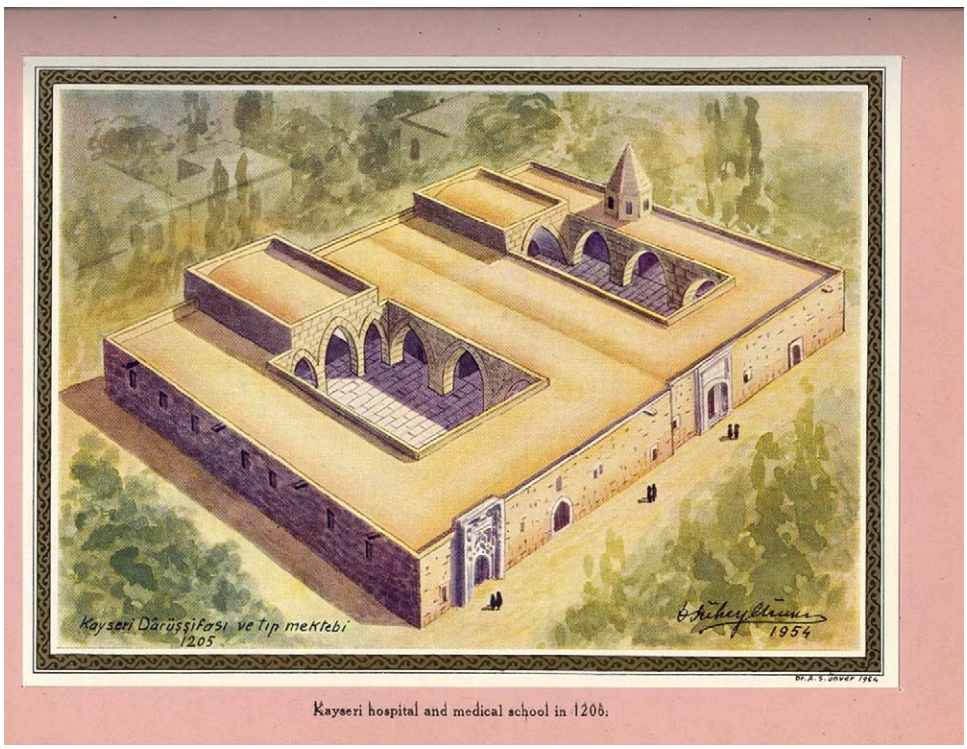


Fig. 3. Gevher Nesibe Hospital of Kayseri.

Fig. 4. Illustration showing the treatment of hydrocephalus as shown in *Cerrahiyetül haniye* (with permission of Turkish Historical Society).

In the first half of the 19th century, the Ottoman Empire realized the failure of the traditional treatment modalities. It was, therefore, decided to establish novel medical institutions. On March 14, 1927, two separate institutions, Tıphane (School of Medicine) and Cerrahhane (School of Surgery) were founded in Istanbul, Capital of the Ottoman Empire. These schools were joined in 1939 and renamed as Mekteb-i Tıbbiye-i Şahane (Royal College of Medicine).

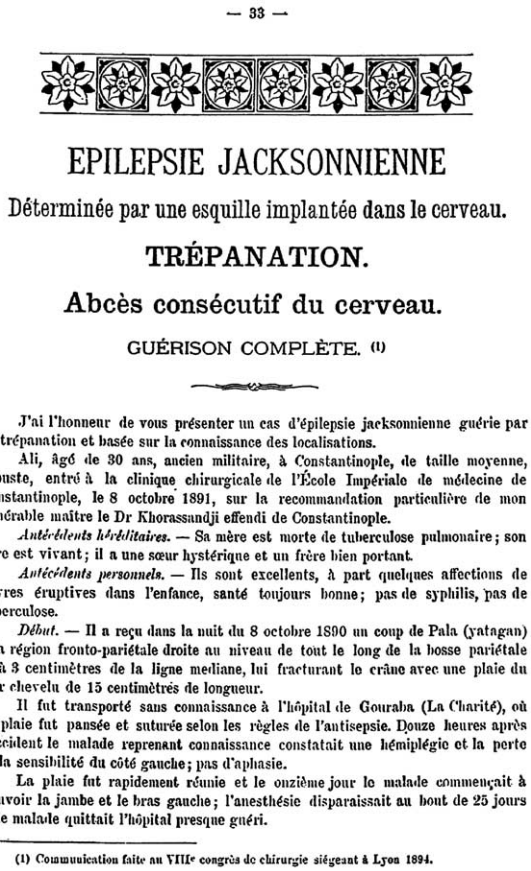
At the same time, there were exciting developments in surgery in Europe, including development of antisepsis and asepsis techniques and surgical techniques. In the second half of the 19th century, many Turkish physicians were sent to European countries for surgical training. Cemil Topuzlu was among the first physicians who went to France, completed his surgery training in Paris, and returned to Turkey.

Cemil Topuzlu (1866-1958) was the pioneer of modern Turkish surgery in Turkey (Fig. 6). He can be accepted as the father of modern surgery in the Ottoman Empire. Among the many surgical procedures he applied in the late

Fig. 5. Illustration showing the treatment of spine dislocation as shown in *Cerrahiyetül haniye* (with permission of Turkish Historical Society).

Fig. 6. Prof Cemil Topuzlu: founder of modern Turkish surgery.

19th century and early 20th century, were many neurosurgical procedures for craniocerebral trauma and infection and surgery for peripheral nerve injuries. He presented a case of brain abscess in a French Surgery Society meeting in 1894 (Fig. 7). This was a report of successful neurosurgical



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EPILEPSIE JACKSONNIENNE

Déterminée par une esquille implantée dans le cerveau.

TRÉPANATION.

Abcès consécutif du cerveau.

GUÉRISON COMPLÈTE. (1)

J'ai l'honneur de vous présenter un cas d'épilepsie jacksonnienne guérie par la trépanation et basée sur la connaissance des localisations.

Ali, âgé de 30 ans, ancien militaire, à Constantinople, de taille moyenne, robuste, entré à la clinique chirurgicale de l'École Impériale de médecine de Constantinople, le 8 octobre 1891, sur la recommandation particulière de mon vénérable maître le Dr Khorassandji effendi de Constantinople.

Antécédents héréditaires. — Sa mère est morte de tuberculose pulmonaire; son père est vivant; il a une sœur hystérique et un frère bien portant.

Antécédents personnels. — Ils sont excellents, à part quelques affections de fièvres éruptives dans l'enfance, santé toujours bonne; pas de syphilis, pas de tuberculose.

Début. — Il a reçu dans la nuit du 8 octobre 1890 un coup de Pala (yatagan) à la région fronto-pariétale droite au niveau de tout le long de la bosse pariétale et à 3 centimètres de la ligne mediane, lui fracturant le crâne avec une plaie du cuir chevelu de 15 centimètres de longueur.

Il fut transporté sans connaissance à l'hôpital de Gouraba (La Charité), où la plaie fut pansée et suturée selon les règles de l'antisepsie. Douze heures après l'accident le malade reprenant connaissance constatait une hémiplégie et la perte de la sensibilité du côté gauche; pas d'aphasie.

La plaie fut rapidement réunie et le onzième jour le malade commençait à mouvoir la jambe et le bras gauche; l'anesthésie disparaissait au bout de 25 jours et le malade quittait l'hôpital presque guéri.

(1) Communication faite au VIII^e^ congrès de chirurgie siégeant à Lyon 1894.

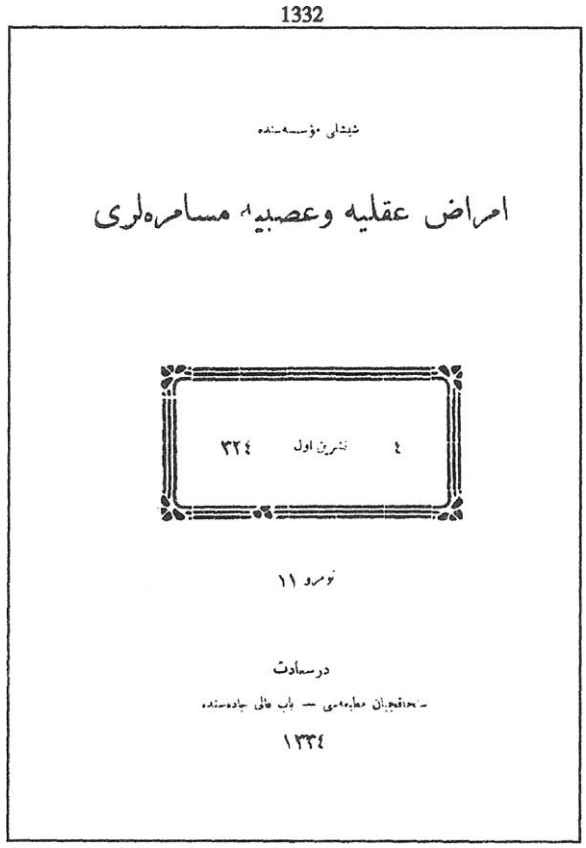
Fig. 7. The first page of the article of Dr Topuzlu regarding successful drainage of the brain abscess.

drainage of brain abscess just a few years after the report of McEwen. It is of note that if he had been able to publish this case report in any important Western surgical journal, he might have been accepted as the pioneer of premodern neurological surgery [3].

During the Ottoman Age (ie, until 1923), there was no neurosurgeon in Turkey. Therefore, it is not surprising that neurosurgical procedures in that age were performed by general surgeons and ear, nose, and throat surgeons such as Alexander Kamburoğlu (?-1913), Garabe Yahoub (1865-1936), Prof Julius Wieting (1868-1922), Kerim Sebati (1870-1942), Orhan Abdi (1878-1948), Mim Kemal Öke (1884-1955), and Murat Cankat (1886-1963). Among the aforementioned surgeons, Dr Mim Kemal Öke was an especially brilliant surgeon. He wrote the first Turkish brain surgery textbook, Dimağ ve Cümcüme Afetleri ve Tedavileri [*Craniocerebral Disorders and Their Treatment*], in 1924 [15].

The main neurosurgical applications during the Ottoman Empire included craniotomies for brain tumors, laminectomies for spinal traumas and infections, surgery for peripheral nerve injuries, surgery for congenital disorders such as hydrocephalus and meningocele, and functional neurosurgical applications for spasticity and trigeminal neuralgia. The aforementioned neurosurgical applications were performed in Darulfunun Medical School (a school formed by the joining of military and civil medical schools), in Gülhane Military Training Hospital, and in private hospitals.

The developments contributing to Turkish neurosurgery in the early 20th century were not limited to the surgical advancements; there were also some advancements in neuroscience. Although there were a number of psychiatrists in the late 19th century in Istanbul, the emergence of neuroscience in the Ottoman Empire and in the young Republic of Turkey should be attributed to Mazhar Osman (1884-1955), a neuropsychiatrist who completed his training in Germany with Kreaplin (the founder of organic psychiatry). Under the influence of the organic psychiatry doctrine, Mazhar Osman (Fig. 8) tried to discover organic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امراض عقليه وعصبيه مسامره‌لرى

درسعادت

Fig. 9. The cover page of the first neuroscience journal, Şişli Müessesesinde Emrâz-ı Akliye ve Asabiye Müsâmereleri, published between 1916 and 1918 (courtesy of Dr Sahap Erkoc).

reasons for most neuropsychiatric problems. Mazhar Osman diagnosed and reported many neurosurgical cases and localized them for surgeons. Review of the more than 25 neurosurgical articles written by Mazhar Osman reveals that he was aware of contemporary neurosurgical literature [17]. In 1918, he reported the necessity for the building of special institutions for neurosurgical applications. Dr Osman published the first Turkish neuroscience journal, Emraz Akliye ve Asabiye Müsamereleri, between

Fig. 8. Dr Mazhar Osman: founder of modern neuroscience in Turkey.

Fig. 10. Dr Abdulkadir Cahit Tuner.

Fig. 11. The article reporting the first spine tumor.

1916 and 1918, containing 11 articles regarding neurosurgery (Fig. 9) [9].

6. Republic of Turkey

After the Ottoman Empire lost World War I in 1918, the empire's lands were invaded. A war of independence began, and all foreign armies left Turkey in 1922. The Republic of Turkey was finally founded by Mustafa Kemal Atatürk in 1923.

Mazhar Osman, founder of modern neuroscience in those days, sent many neuropsychiatrists for training in experimental psychiatry, neurology, neuropathology, and neurosurgery. Dr Abdulkadir Cahit Tuner (1892-1980) was one of the aforementioned fellows who went to Breslau, Germany, for training in neurosurgery (Fig. 10). He was trained for almost 1 year in the department of Dr Foerster. On returning, Dr Tuner established the first neurosurgery department in Zeynep Kamil Hospital. He worked in this center between 1923 and 1927 [11,17]. He performed the first successful laminectomies for spinal tumors, some craniotomies for brain tumors, and saline injection to the gasserian ganglion for trigeminal neuralgia (Fig. 11). Unfortunately, after a dispute with Mazhar Osman, he gave up surgery in 1927. This led to an interruption of neurosurgical organization in Turkey until the mid 1930s.

Fig. 12. Dr Hami Dilek.

Nevertheless, Dr Osman was aware of the need for neurosurgeons, which led him to send a second person abroad for neurosurgery training, this time selecting a general surgeon instead of a neurologist. He sent Dr Hami Dilek to Paris (Fig. 12). Dr Dilek worked as fellow of Dr Vincent and Dr De Martel and returned to Turkey in 1936 [5]. Aside from Dr Dilek, Dr Baydur, Dr Kankat, and Dr Sakarya were other surgeons who trained in neurosurgery abroad in the 1930s.

Both Dr Baydur and Dr Kankat worked with Dr Clovis and Dr De Martel, as did Dr Dilek. Dr Sakarya was fellow of Dr Walter E. Dandy. Dr Baydur published the first Turkish book of neurosurgery, Nöroşirürji Bahisleri[1] [6]. Dr Kankat worked in a private hospital, Şişli Cerrahi Hastanesi. He published the first Turkish neurosurgery journal, Modern Cerrahi ve Nöroşirürji Mecmuası. This interesting journal was published between 1936 and 1947 [16] and is one of the earliest neurosurgery journals in the world.

[1] Before this book, a brain surgery book, *Dimag ve cumcume afetleri ve tedavileri*, was published in Ottomanish in 1924 by a general surgeon, Dr Mim Kemal Öke.

Dr Sakarya could not work effectively as a neurosurgeon [18]. Among the neurosurgeons of this decade, Dr Dilek was able to work most effectively. He established a neurosurgery department in 2 different hospitals, including Bakyrköy Hospital and Haydarpaşa Numune Hospital. After legalization of a training program in neurosurgery in 1947, Dr Dilek was the first program director for neurosurgery [5].

Apart from these neurosurgical training programs, others were developed in university hospitals in subsequent years. The first university in which neurosurgery training was established was Istanbul University, founded in 1933, just 10 years after the Turkish Independence War, by order of Atatürk. In contrast to previous medical and engineering schools, Istanbul University was established to increase the scientific level of education in the young Republic of Turkey. Dr Nissen (1896-1981), the famous German general surgeon, was the chair of one of two general surgery departments between 1933 and 1939. He performed some sporadic neurosurgical applications, including cerebral and spinal tumors, peripheral nerve procedures, and craniospinal trauma cases. He was against subspecialization in neurosurgery [12]. After he left Turkey, 2 Turkish surgeons went abroad for neurosurgery training. Dr Feyyaz Berkay (1915-1993) (Fig. 13) went to the United States and worked with Dr Klemme at St. Louis University (St. Louis, Mo). He was the first Turkish surgeon to complete formal neurosurgery training. Working between 1946 and 1951 in the United States, he was certified to the American Board of Neurosurgery [2].

Another surgeon of Istanbul University, Dr Bülent Tarcan (1914-1991) (Fig. 14), went to England in 1950 and worked with Dr Nortfield and returned in 1953.

Thus, in the early 1950s, the first university neurosurgery training centers were established in two different schools of medicine of Istanbul University. The first neurosurgery training centers in other cities included Hacettepe University in 1959, founded by Vahdettin Türkmen; Ankara University in 1965, founded by Nurhan Avman (Fig. 15); Ege University in 1967, founded by Erdem Tunçbay; and Çukurova University in 1972. Other centers were established in subsequent years.

As mentioned, Ankara was the second city in which neurosurgery departments were established. However, it is of note that neurosurgical applications were performed before the establishment of neurosurgical institutions in Ankara by Prof Melchior (1883-1974), a German surgeon who worked between 1936 and 1954 in the Department of Surgery of Ankara University. He operated many cases of craniospinal trauma, meningioma, and spinal infections [13].

In 1959, Dr Türkmen, a neurosurgeon who completed his training at the Philadelphia Medical Center, University of Pennsylvania, with Prof Grant founded the Neurosurgery Department in Hacettepe University School of Medicine. After he left Turkey in 1960, Dr Nurhan Avman (1928-1968), a previous resident under Dr Poppen (The Lahey Clinic, Boston, Mass) and Dr Sachs Jr (Dartmouth College School of Medicine, Hanover, NH), directed this department until 1965, followed by Dr Aykut Erbengi. After leaving Hacettepe University, Dr Avman founded the Neurosurgery Department in Ankara University in 1965.

At present, there are 58 neurosurgery training centers and more than 500 neurosurgeons in Turkey. The training program consists of 6 years of training, including 19 months of rotations.

Fig. 14. Dr Bülent Tarcan.

Fig. 13. Dr Feyyaz Berkay.

Fig. 15. Dr Nurhan Avman.

7. Neurosurgery training and organization

The first neurosurgery program was accepted in 1947, but it has undergone revisions since that time. Surgeons must pass an examination in their teaching hospitals regulated by the Ministry of Health before they can be certified as a specialist in neurosurgery.

The current neurosurgery training takes 6 years. It consists of 10 months of neurology, 6 months of general surgery, 2 months of pathology, and 1 month of anesthesiology.

The Turkish Neurosurgical Society was founded in 1968 by 11 neurosurgeons in Istanbul. This society was closed in 1982. In 1985, the new Turkish Neurosurgery Society was founded, with Dr Avman serving as its first chair. The subsequent chairs included Dr Erbengi, Dr Özgen, Dr Gürçay, Dr Kanpolat, Dr Özcan, Dr Arasıl, Dr Taşkın, Dr Altınörs, Dr Baykaner, Dr Aksoy, Dr Pamir, Dr Özdamar, and Dr Palaoğlu.

Many committees and groups were established under the patronage of the society, including pediatric neurosurgery, spine and peripheral nerve surgery, functional and stereotactic surgery, neuro-oncology, neurotrauma and intensive care unit, skull-base surgery, cerebrovascular surgery, and surgical neuroanatomy. The effective works of these groups have provided for the development of subspecialization in Turkey, although there is no official specific subspecialization fellowship program.

8. Conclusion

There has been a variety of civilizations throughout history in Turkey and in Anatolia. These civilizations influenced all aspects of social life, medicine, and, particularly surgery, in both Seljuks and Ottoman periods. Medicine and surgery during this age, therefore, had ancient, Islamic, and Western roots. In the mid–19th century, Ottomans turned toward Western medicine. Thus began the journey of modern medicine and surgery in this country. The history of modern surgery began in 1890; the first neurosurgeon, Dr Tuner, started to work and established the first neurosurgery department in 1923. In the mid 1930s, 4 surgeons were trained in neurosurgery. In 1947, the first neurosurgery training program was legalized. Currently, there are more than 500 neurosurgeons in Turkey. Apart from the application of neurosurgical procedures, there have been many scientific studies in neuroscience, and these have contributed to the body of literature.

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