13 History of Stereotactic Surgery in Korea

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In Korean history, the end of the nineteenth century is considered as the period of the Chosun Dynasty's transition from medieval to modern. This period was marked by wide-ranging social and economic changes on the domestic front, and, externally, by the threat of foreign domination. It was during this period when modern medicine began, perhaps personified historically when Dr. Horace N. Allen (*Figure 13-1*), a Protestant missionary from the Presbyterian Missions in New York, stepped onto Korean soil. In December 1884, Allen was given the opportunity of saving the life of Queen Min's nephew. In gratitude, at the behest of King Kojong, the Royal Hospital Kwanghyewon, "House of Extended Grace," was founded on 10 April 1885, and on April 23rd the name was changed to Chejungwon (*Figure 13-2*), which means "Universal Helpfulness," Kwanghyewon was the first modern hospital in Korea, which later became the Severance Hospital, an affiliate of the Yonsei University Medical School [1,2].

The hospital provided a legitimate venue for the first protestant missionaries to pursue their religious activities while conducting systematic research on diseases endemic to Korea. In March 1886, a year after the founding of Chejungwon, the hospital launched its Medical Department to educate future medical practitioners and professionals in modern medicine, aiming to treat the ailments of the Korean people.

Since Allen had been appointed as head of the hospital, J. E. Heron, Charles C. Vinton, and Oliver R. Avison (*Figure 13-3*) successfully carried on his work as a director of the hospital.

As the result of advances made possible by Avison's fund-raising initiatives in the United States, in 1899 the Medical Department of Chejungwon was accredited as a full-fledged medical educational institution. An American entrepreneur, Louis H. Severance, deeply moved by Avison's speech about his missionary activities in Chosun, decided to donate $10,000, a very large sum of money in 1900.

With funding provided by Severance, a new hospital building was completed on 23 September 1904. It was named Severance Hospital (*Figure 13-4*) to commemorate the man who had made it possible. It was Korea's first modern Western style hospital building.

In 1908, the Chejungwon Medical School (later Yonsei University Medical School) celebrated its first graduation. While the Chejungwon Medical School was founded and established, several medical schools were also founded in sequence.

In the early 1940s, a few pioneering general surgeons started to practice neurosurgical procedures in medical school accredited hospitals. The neurosurgical procedures included neurotraumas, epilepsy surgeries, and surgeries for mental disorders. Actually all the early stage neurosurgeons were functional neurosurgeons.

In 1943, Dr. Chu Kul Lee performed corticectomy on a patient with posttraumatic epilepsy. Dr. Lee graduated from Daegu Medical College (later Kyungbook National University) in 1937 and continued to study neurosurgery in Nagoya University, Japan. He returned to Korea in 1942 and proceeded to perform cortical resection for epilepsy patients in Seoul's Women's Medical College (later Korea University Medical College).

Later on he conducted cortical coagulation to interrupt the epileptic impulse in patients with epilepsy. He was interested in epilepsy surgery throughout his neurosurgical career and published his experience in the first issue of the official *Journal of the Korean Neurosurgical Society* in 1972 [3]. He was a leading figure in the neurosurgical field and trained many neurosurgeons in 1960s. He was elected as the first president of the Korean Neurosurgical Society in 1961.

Another pioneer was Dr. Ki Sup Lee. He graduated from Severance Medical College (later Yonsei University) and studied neurosurgery in Kyoto University, Japan. He performed frontal lobotomy for mental disorder, corticectomy for epilepsy, and sympathectomy for pain in Severance hospital in 1943 (Lee KS, 1996, personal communication). Dr. Si Chang Kim graduated from Kyungsung University (later Seoul National University) in 1936. At one stage, he worked in Seoul Women's Medical College and returned to Kyungsung University Hospital in 1948 where he performed corticectomy and cortical vessel ligation for epilepsy sufferers. He was one of the handful number of active surgeons practicing neurosurgery at that time. Unfortunately, he was

Figure 13-1
Dr. Horace N. Allen; Presbyterian missionary from New York who founded the first Western style hospital, Chejungwon on 10 April 1885

Figure 13-2
Chejungwon in Seoul (1885); the first Western style hospital in Korea

abducted and taken to North Korea during the Korean War (Moon TJ, Forty years History of the Korean Neurosurgical Society (1961∼2001), 2002, personal communication).

Figure 13-3
Oliver R. Avison (served 1893–1935); Canadian missionary who was director of Chejungwon hospital and later Dean of Severance Medical College

The Korean War broke out on the 25 June 1950. War-related trauma injuries provided great momentum to the development of neurosurgery in Korea. During the Korean War, Scandinavian countries sent the Danish hospital ship *Jutlandia* to Busan to care of casualties. The chief neurosurgeon on this ship was Professor Edward A. V. Busch from Copenhagen University, Denmark, and his assistant was Dr. K. Vaernet. They not only treated patients but also taught neurology and neurosurgery to Korean military surgeons. Many American military surgeons also came to Korea during the war, among them colonel Arnold M. Meirowsky and George J. Hayes contributed enormously to the development of neurosurgery in Korea. They served in the mobile army surgical hospitals (MASH) and also taught neurosurgery to Korean military surgeons [4]. Some Korean surgeons had several months of continuous neurosurgical training, which served them well in organizing neurosurgical teams. Casualties from the war included patients with cranio-spinal trauma, peripheral nerve injury, and causalgia. The neurosurgeons in the army

Figure 13-4
Severance Hospital (1904), the first Western style hospital building in Korea. Louis H. Severance, businessman from Cleveland, donated for the new hospital building and Chejungwon Hospital was renamed as Severance Hospital

performed many thoracic sympathectomy for patients with causalgia. It was a great opportunity for the Korean neurosurgeons to observe Western medicine and neurosurgical practices. After the war some of them continued to practice neurosurgery while others went abroad to study neurosurgery in Western countries [4].

In the late 1950s, neurosurgeons who went abroad came back to Korea after completing neurosurgical training. Dr. Tae Joon Moon had residency training at Thomas Jefferson University (USA), and became a qualified neurosurgeon by the time he came back in 1957. Upon his return, he practiced neurosurgery in Yonsei University and performed trigeminal ganglion block with hot saline or absolute alcohol in the treatment of trigeminal neuralgia and open thoracic cordotomy for intractable cancer pain. Dr. Bo Sung Sim graduated from Seoul National University in 1949. He served as an army neurosurgeon during the Korean War and studied neurosurgery in Minnesota University (USA). He performed hemispherectomy in patients with intractable epilepsy due to cerebral paragonimiasis in 1958. He also performed retrogasserian rhizotomy in the middle cranial fossa for trigeminal neuralgia [4]. Dr. Hun Jae Lee graduated from Severance Medical College in 1944 and finished his residency program in Michigan University Hospital (USA) to become a qualified neurosurgeon. He came to Seoul Women's Medical College in 1959, after which he performed open cordotomy for intractable cancer pain and retrogasserian rhizotomy for trigeminal neuralgia, while also applying alcohol in gasserian ganglion percutaneously for trigeminal neuralgia [5]. Dr. Kon Huh graduated from Severance Medical College in 1948, and continued studying neurosurgery in Wisconsin University (USA). He came back to Severance Medical College in 1962 where he practiced pain surgery such as open cordotomy or retrogasserian rhizotomy in middle cranial fossa [4]. Dr. Jeong Wha Chu graduated from Seoul National University in 1956, and studied neurosurgery in Minnesota University (USA). After coming back from Minnesota University in 1961, he practiced some ablative pain surgeries such as open cordotomy and retrogasserian rhizotomy in middle cranial fossa [6].

Stereotactic surgery in Korea began in the early 1960s. Dr. Hun Jae Lee performed chemothalamotomy in patients with Parkinson's disease using Cooper's frame in 1960. It was the first stereotactic surgery using stereotactic apparatus in Korea. He presented the results of chemothalamotomy in seven cases of Parkinson's disease patients and four cases of dystonia patients. He reported on follow up results of those patients in 1963 (Chu JW, 2006, personal communication). Dr. Tae Joon Moon also performed thalamotomy using simple burr hole mounted Mackinie apparatus. Dr. Chul Woo Lee of Kyungbook University, who trained at the Saint Vincent Hospital in Wooster city near Boston (USA), made his own stereotactic frame in 1960. He performed thalamotomy for patients with dystonia and Parkinson's disease. Dr. Jeong Wha Chu also performed thalamotomy for patients with Parkinson's disease [6]. However, there were very few neurosurgeons who carried out stereotactic surgery for movement disorders at that time.

In 1971, the radiofrequency lesion generator was introduced in to Korea.

Sang Sup Chung of Yonsei University performed percutaneous radiofrequency cervical cordotomy, radiofrequency trigeminal thermocoagulation, and radiofrequency ventrolateral thalamotomy for Parkinson's disease sufferers in 1972 [7,8]. In 1973, radiofrequency facial nerve neurotomy was performed for hemifacial spasm at the stylomastoid foramen [9]. It was the beginning of the subspecialty of stereotactic and functional neurosurgery in Korea. Introduction of radiofrequency lesion generator made it possible for many procedures to be conducted percutaneously, allowing for a more accurate,

safer, and simpler operation. In 1976, Computed tomography (CT) scanner was introduced in to Korea. The introduction of radiofrequency lesion generator and CT scanners were substantial moments for the development of stereotactic and functional neurosurgery in Korea.

In 1975, Sang Sup Chung went to Edinburgh University, Britain, for further study where he practiced stereotactic and functional neurosurgery under professors F. John Gillingham and Edward R. Hitchcock. After returning to Yonsei University he became a fulltime stereotactic and functional neurosurgeon. In 1976, Chang Rak Choi studied functional neurosurgery under professor Umbach in Berlin, Germany, and came back to Catholic University where he continued to practice stereotactic and functional neurosurgery.

In 1978, Dr. Kil Soo Choi and Dr. Hun Jae Lee performed microvascular decompression for hemifacial spasm and trigeminal neuralgia. Soon after, Sang Sung Chung followed the procedures [10]. In 1979, depth recording was performed using semi-micro electrode during thalamotomy.

In the 1980s there was rapid progress in research activities and surgical techniques in Korea. Various stereotactic and functional surgeries were performed. In 1980, Sang Sup Chung performed stereotactic chemical or radiofrequency hypophysectomy [11], percutaneous spinal rhizotomy and percutaneous medullary trigeminal tractotomy in treating cancer pain. Dorsal root entry zone lesioning and facet denervation were performed for chronic intractable pain and for chronic low back pain. Centrum medianum and parafacicularis nucleus lesioning were done for chronic central pain. Hypothalamotomy was performed for aggressive psychosis and glycerol injection was introduced as a treatment modality for trigeminal neuralgia. Also in 1980, percutaneous spinal cord stimulation for chronic pain and intrathecal infusion pump were introduced for cancer pain. However, these devices were not covered by insurances and it was difficult to treat many patients in the early stages of diagnosis because of economic problems. During this period, various newly developed functional neurosurgical procedures were attempted while a number of stereotactic apparatus such as Todd-Wells, Riechert-Mundinger, Guiot-Gillingham, BRW frame were introduced in to Korea.

In the 1980s, CT compatible CRW, Hitchcock, and Leksell frame, which were introduced, enabled surgeons to perform image guided surgery. In 1984, stereotactic evacuation of intracerebral hematoma or brain biopsy was carried out by CT image guided surgery.

In 1982, Moon Chan Kim came back to Catholic Medical College after studying in Birmingham under Professor Hitchcock. As a full time neurosurgeon, he practiced surgery for movement disorder, pain, and psychiatric illness. In 1988, linear accelerated based radiosurgery were performed by Moon Chan Kim and Sang Sup Chung. In 1988, Sang Sup Chung performed adrenal gland transplantation for Parkinson's disease sufferers and reported on the 5 year follow-up results in 1993 [12].

Epilepsy surgery was conducted sporadically from its inception. However, a comprehensive epilepsy protocol (Yonsei Epilepsy Protocol) was established in 1989, after which epilepsy surgery became more standardized and several centers were built.

During the 1990s, stereotactic and functional neurosurgery achieved substantial development owing to the great technological advancements in computer science, surgical softwares, engineering, neurophysiology, and various diagnostic tools. The resolution of MRI improved immensely and accurate MRI guided surgery became possible from 1995. In 1999, vagal nerve stimulation was done for intractable epilepsy and micro-depth recording started during thalamotomy. Deep brain stimulation for Parkinson's disease was introduced in 2000 by Jin Woo Chang and Sang Sup Chung.

From late 1980s through to the 1990s, many young neurosurgeons were getting interested

in stereotactic and functional neurosurgery. Uhn Lee of Ghil Hospital, who graduated from Hanyang University, is an active neurosurgeon who treats patients with movement disorders. He conducted thalamotomy and pallidotomy in the late 1980s and now continues to practice DBS. Jae Hyoo Kim of Chonnam University is also an active functional neurosurgeon, who is carrying out pain surgery, DBS for movement disorders and sympathectomy for hyperhidrosis. Jin Woo Chang graduated from Yonsei University and studied at the University of Chicago (USA). He is also an active functional neurosurgeon doing DBS surgery for movement disorders, pain surgery and psychosurgery. Others are Sung Nam Hwang of Chungang University, Young Soo Kim of Hanyang University, Yong Tae Chung of Busan Baik Hospital, Kyung Jin Lee of Catholic University, Jung Yul Park of Korea University, Seong Ho Kim of Yeungnam University, Young Hwan Ahn of Ajou University, Jeong Il Lee of Samsung Medical Center, Moo Seong Kim of Busan Baik Hospital and Ryoong Huh of Pochon Cha University. They are all active in the treatment of movement disorders or pain surgery.

The Korean stereotactic and functional neurosurgery society was founded on February 24th 1990, and the first president and secretary were Sang Sup Chung and Chang Rok Choi, respectively (*Figure 13-5*). Approximately 150 members were registered with the society in 2006. In 1996, Sang Sup Chung was elected as the president of the Asian Society of Stereotactic, Functional and Computer assisted Neurosurgery. In 1999, he held the third Asian Society meeting in Seoul successfully (*Figure 13-6*).

The first Gamma Knife unit was installed in 1990, and now there are 11 gamma knife units

Figure 13-5
The first meeting of the Korean Sterotactic and Functional Neurosurgery Society; Seoul, February 24, 1990

Figure 13-6
The third meeting of Asian Society of Sterotactic, Functional and Computer assisted Neurosurgery; Seoul, June 13, 1999

in Korea. In 2006, 2700 gamma knife radiosurgeries were conducted in Korea. The gamma knife radiosurgery society meeting was held on 15th of November 2002 and there have been also annual meetings thereafter. The neurosurgeons involved in radiosurgery are Yong Gou Park of Yonsei University, Dong Gyu Kim of Seoul National University, Young Jin Lim of Kyunghee University, Do Hoon Kwon of Seoul Asan Hospital, and Chang Wha Choi of Busan National University. In 2006, Dong Gyu Kim organized the 13th international meeting of Leksell gammma knife society in Seoul successfully.

In the beginning of functional neurosurgery, our pioneers conducted epilepsy surgery, while epilepsy surgery according to a comprehensive proocol began in 1989. The Korean epilepsy society was founded in 1996 and Sang Sup Chung was elected as the first president. Many active and functional neurosurgeons are participating members of the epilepsy society. Active epilepsy surgeons are Jung Kyo Lee of Seoul Asan Hospital of Ulsan University, Hyung IL Kim of Chunju Presbyterian Hospital, Eun Ik Son of Kyemyung University, Seung Chyul Hong of Samsung Hospital, Chun Kee Chung of Seoul National University, Ha Young Choi of Chonbuk National University and Jong Hee Chang of Yonsei University.

Many of the institutes use Leksell stereotactic apparatus while 54 hospitals have Leksell apparatus. Many of the hospitals are using the apparatus simply to conduct brain biopsy or evacuation of hematoma. Nineteen hospitals performed 271 DBSs in 2006; 190 Parkinson's

disease, 34 Essential tremors & 36 Dystonia. There were also clinical experiment of DBS for epilepsy and psychiatric disorders.

With more than 60 years of achievement, stereotactic and functional neurosurgery has evolved and become one of important fields of neurosurgery in Korea.

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