

OPERATIVE ARTHROSCOPY

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RAVEN PRESS  NEW YORK

CHAPTER 1

History of Arthroscopy

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The earliest evidence of man's insatiable desire to explore the interior of body cavities is documented by references to vaginal speculi in the ancient Hebrew literature and by the discovery of proctoscopes in the ruins of Pompeii. The bladder, however, has been the most intriguing organ and has also provided the major incentive in the development of endoscopic devices. In 1806 Botzini (1773-1809) (1) presented his "Lichtleiter" to the Joseph Academy of Medical Surgery in Vienna, but the concept was not well received. His apparatus consisted of two simple tubes and a candle as a light source. The candlelight was reflected into the bladder of a patient through one of the tubes, and the surgeon would look through the other tube to visualize the contents. In 1853 Desormaux (1815-1882) produced the gazogene endocystoscope. A mixture of turpentine and alcohol was used to provide the fuel for a fire in a small combustion chamber, the light of which was transmitted via mirrors into the bladder through a fairly large tube, which was also used for visualization. In 1876 Max Nitze (1848-1906) developed the first modern cystoscope. A platinum loop heated by electricity and encased in a water-cooled goose quill provided the light source within the bladder. In 1880 Edison developed the incandescent lamp, which solved all the previous problems of illumination and proved to be a milestone in the science of endoscopy. Cystoscopy then flourished, and arthroscopy, originally called arthroendoscopy, or the exploration of joint cavities, was a natural evolution.

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THE DUAL BEGINNINGS

The East

Professor Kenji Takagi (1888-1963) of Tokyo University is given credit for being the first to apply the principles of endoscopy successfully to a knee joint when, in 1918, he viewed the interior of a cadaver knee using a cystoscope. The stimulus for his work was the disastrous end result of tuberculosis of the knee, which was rampant at that time and usually resulted in an ankylosed knee. Stiff knees, to Japanese citizens, represented a serious social as well as physical disability, as they were unable to kneel or squat, both important motions in their society. Professor Takagi hoped to detect tuberculous arthritis early and provide more appropriate and successful treatment. In 1919 he used a 7.3-mm cystoscope. The evolution of the technique was slow at first, but over the space of a few years he developed specific instruments for arthroscopic use and numbered them consecutively. In 1931 the #1 Takagi scope was available, and on July 6, 1932 he gave the first report of this instrument to the Japanese Orthopaedic Association in Tokyo. He illustrated his report with black-and-white pictures taken through the scope. In 1936 he was successful in obtaining color pictures and a movie film.

During this developmental phase, Dr. Saburo Iino worked closely with Takagi in documenting the pathology seen within the knee joint and was the first to describe and name the various plicae, or folds, of synovium within the joint.

Unfortunately, from 1939 to 1945 World War II significantly disrupted advances in this area of science. Fol-

Following World War II, Dr. Masaki Watanabe, a student of Professor Takagi, continued his work. In 1951 the #13 arthroscope was developed and attributed to Dr. Watanabe. In 1958 he released the Watanabe #21; it proved to be the first truly successful arthroscope.

This magnificent scope had a lens with an angle of vision of 102° and a depth of focus from 0.5 mm to infinity. The lenses were produced by a craftsman named Fukuyo who ground each lens by hand. The incandescent light bulb at the end of the scope was offset and protruded slightly beyond the lens. It provided excellent illumination and was also useful for pushing synovial fronds out of the visual field. However, when used by inexperienced arthroscopists, the bulb was also the "Achilles' heel" of the instrument, as it was frequently caught on synovial folds within the joint, causing it to bend away from the lens and sometimes break off.

"Cold light" or fiber light was the next major advance and was a feature of the Watanabe #22 arthroscope. Smaller diameter scopes, such as the #24, which measured 2 mm in diameter and consisted of a single fiber of glass, soon followed. With the development of usable instruments, the next major technical advance was mass production of the instruments.

Recognizing the potential significance of his pioneering efforts, Dr. Watanabe kept immaculate records. His first surgical procedure under arthroscopic control was the removal of an xanthomatous giant cell tumor on March 9, 1955. His first meniscectomy under arthroscopic control was performed on May 4, 1962. His colleagues Dr. Hiroshi Ikeuchi and Dr. Sakae Takeda also deserve much credit, as they played a significant role in the early development of the technique of operative arthroscopy.

In 1957 the first edition of Watanabe's *Atlas of Arthroscopy* (4) was published, with Takeda and Ikeuchi as coauthors. This classic atlas was beautifully illustrated by S. Fujihashi. It was revised and republished in 1969 (5), with actual photographs of joint pathology.

The West

Simultaneously with the development of arthroscopy in the East, Dr. Eugen Bircher (1882-1956) introduced the Jacobeus laparoscope into a knee in 1921 and called the technique "arthro-endoscopy." He used gas (carbon monoxide) to distend the joint and wrote about posttraumatic arthritis and the accurate diagnosis of meniscal pathology in articles published in 1921 and 1922 (6). One of Bircher's early assistants was identified as Dr. Paul Foster, but little is known about this surgeon. Dr. Bircher's son is a practicing general surgeon in Switzerland and graciously provided information about his father and the early days of arthroscopy.

The first U.S. article on arthroscopy appeared in 1925 (7), when Dr. Phillip Kreuzer (1884-1943) published a

plea for the use of arthroscopy in the early recognition and treatment of meniscal lesions. The type of arthroscope he used is not known.

In 1930 Dr. Michael Burman (1901-1975) of the Hospital for Joint Diseases in New York, spent a fellowship year in Berlin studying endoscopic techniques. He returned to the United States and, with a 4-mm diameter arthroscope constructed by Mr. R. Wappler, examined every joint of the body using cadavers. Along with Drs. Mayer, Finkelstein, and Sutro, he then published several classic articles (8-11) on this new method of examining joints. His subsequent applications to humans proved innovative but were met with skepticism by his colleagues. He also had numerous problems with the technology of the time and experienced frequent breakage of his equipment. He did, however, prepare a text for a monograph on arthroscopy, which was never published, and was the first to experiment with intravital staining to delineate degenerative articular cartilage.

In the German literature, Sommer in 1937 (12) and Vaubel in 1938 (13) reported on their experiences with the technique. Due to the turmoil surrounding World War II and the general dedication of science to military matters, there were no significant advances in arthroscopy from 1939 to 1945. Following World War II, Hurter published in the French literature in 1955 (14) and Imbert also published in French in 1956-1957 (15).

THE REAWAKENING

In 1964 I went to Tokyo University with the primary purpose of studying tissue culture techniques. On meeting Watanabe and observing arthroscopic procedures (Fig. 1), I became convinced that the technique offered a major contribution to the diagnosis and treatment of joint pathology. I returned to the Toronto General Hospital in 1965 and began to practice arthroscopy using the Watanabe #21 arthroscope. In 1966 Dr. Isao Abe from Tokyo joined me in Toronto and helped develop the present technique. In 1967 a short presentation on the subject of arthroscopy was given at the inaugural meeting of the Association of Academic Surgeons held in Toronto, and in 1968, the first instructional course was given by me at the annual meeting of the American Academy of Orthopaedic Surgeons. The only other people in the western world doing any significant amount of arthroscopy at that time were rheumatologists such as Drs. Jason and Dixon in England, and Dr. Robles Gil in Mexico.

THE SPREADING AWARENESS

Interest in the technique rapidly spread. Among the early pioneers were Drs. Ward Casscells and Jack McGinty, who visited me in 1967 and began to make their



FIG. 1. Drs. Ikeuchi and Jackson (left) discuss cases with Dr. Watanabe at Tokyo Teishin Hospital in 1964.

own significant contributions to this field. In 1969 Dr. Richard O'Connor visited Watanabe in Tokyo and soon began to explore new avenues in arthroscopic surgery. Other North American surgeons who played instrumental roles in the development of instruments, techniques, and teaching were Drs. Lanny Johnson, John Joyce III, Ken DeHaven, and Ralph Lidge.

In Europe, Dr. Harold Eikelaar defended his thesis on arthroscopy in 1973 and received the highest degree possible in surgery from the University of Grönigen in Holland. Drs. Jan Gillquist and Enjar Eriksson in Sweden, Dr. Hans Rudolph Henche in Switzerland, and Dr. John Ohnsorge in Germany also played pivotal roles in teaching and developing new techniques of arthroscopy. In 1974 Dr. David Dandy, doing a fellowship year in Toronto, reviewed my experience and coauthored the first English monograph text on the subject of arthroscopy (2).

In 1972 the International Arthroscopy Association (IAA) was founded in Philadelphia, and Professor Watanabe was elected the first chairman. The prime purpose of the IAA was to educate orthopedic surgeons to the value of the technique and to spread awareness of arthroscopy to all parts of the world. Numerous courses were thereafter developed, under the aegis of both the IAA and various universities. The first major course in arthroscopy was given in 1973 at the University of Pennsylvania under the chairmanship of Dr. John Joyce. A tremendous boom

in arthroscopic teaching occurred over the next 10 years as more and more people became increasingly aware of the potential of this technique. In 1982, the Arthroscopy Association of North America was founded and is now the largest such association in the world.

THE THERAPEUTIC ADVANTAGE

Although Drs. Watanabe and Ikeuchi had performed the first arthroscopic meniscectomy in 1962, the early operative procedures done under arthroscopic control were somewhat limited by the equipment available at that time. Biopsies, removal of loose bodies, and trimming of meniscii were all that was possible with the early equipment. However, as special instruments were designed and developed, the therapeutic applications became more apparent. The late Dr. Richard O'Connor deserves credit for his pioneering work in this area. Dr. Robert Metcalf, Dr. Lanny Johnson, and Dr. Dinesh Patel were early proponents and teachers of operative arthroscopy. Each of these individuals developed techniques and instruments with the help of various surgical instrument companies. With the increasing ability to perform definitive surgical procedures on pathology identified at arthroscopy, the interest and awareness in the technique rapidly spread throughout the world.

THE SOPHISTICATED FUTURE.

With the growing number of young, enthusiastic arthroscopists, along with better instrumentation, the basic techniques that were developed for knee surgery have been applied to shoulders, ankles, hips, and virtually every other joint in the body. Increasing numbers of techniques and surgical procedures are being performed under endoscopic control. Stabilizing and resurfacing procedures are being perfected. New surgical instruments are being developed, such as laser surgery and electrosurgery. The revolution in joint surgery, which began in 1919, has already reached the stage at which arthroscopy must be considered one of the greatest contributions in orthopedic surgery in this century—ranking alongside joint arthroplasty.

Where this revolution will end is impossible to predict. The next historian might have the same delightful challenge—to outline even greater advances in the field of arthroscopic surgery.

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