Research Article

History of arthroscopy

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Abstract

Arthroscopy (also called arthroscopic surgery) is a minimally invasive surgical procedure on a joint in which an examination and sometimes treatment of damage is performed using an arthroscope, an endoscope that is inserted into the joint through a small incision.

Key Words: Arthroscopy, history, medicine, knee, tuberculosis.

Introduction

Orthopaedics was always seen as a bloody surgery, which lacks the "delicacy" in the treatment and respect of tissues and anatomical planes. The orthopedics up to the introduction of scopy unfortunately was notable by its sanguineness. As has often happened in medicine an invention for a certain organ it has evolved in other directions. Very often these inventions are forgotten, only to be rediscovered.

The cystoscope born in Italy and evolved in the East

As long ago as 400 a.c., Hippocrates, searched for a method to look inside the organs, he created the first endoscopic instrument of history: a rectal speculum. Romans doctors also tried to produce tools whereby inspect the internal organs.
such as the vaginal speculum with three valve very similar to those of more recent construction. The first real endoscopic instrument was conceived by the Italian Philip Bozzini (1773-1801) that published an essay (Der Lichtleiter - the Bozzini light conductor) where it was described a precursor of the modern cystoscope. In Bozzini’s instrument, which was not designed as a urinary endoscope, but for the study of the ear and the respiratory system, the light of a candle was conducted by means of a mirror in a tube, thus providing sufficient light to explore these cavities. But if Bozzini’s device never had clinical use, it seems because of rivalries within the Medical Academy of Vienna under which it was made, this was undoubtedly the first step in the subsequent development of endoscopy.

In 1826, Pierre Salomon Ségalas'Etchepare presented at the Académie des Sciences the "urethrocystic speculum ", the first instrument designed for the exploration of the urethra and bladder. This consisted of a silver tube, fitted with a spindle, which was adapted to a circular box with two side entrances for the introduction of two small candles. In 1853, still a French surgeon, Antoine Jean Desormeaux, presented to the Faculty of Medicine of Paris the first clinical application of Lichteleiter of Bozzini. The tool was also provided with a slit which allowed the introduction of a pointed rod with the ability to perform urethrotomy under vision. With this instrument that in 1869 Desormeaux resected a urethral neoformation. With Desormeaux one can say that begins the history of scopy in modern surgery.

Unfortunately, a technical problem limited its use. In fact, the light source, with good brightness, was formed by a flame obtained by combustion of ethyl alcohol and turpentine, but this overheats excessively the instrument exposing the patient to serious burns of urethra and penis. Desormeaux is also remembered as the author (1865) of the first endoscopy manual illustrated also by three color plates.

Meanwhile in Pavia, around 1874 and before the affirmation of endoscopy, Enrico Bottini (1835-1903) made the first experiments of transurethral resection. He used the galvanic current to destroy tissue that made up the bladder neck, and to do that he invented an instrument with a 21Ch metal probe, plated with gold and slightly curved at the end, where it ended with a small porcelain body containing a platinum plaque.

This probe was placed in contact with the posterior lip of the bladder neck and heated by means of a galvanic current coming from accumulators. The operation was performed under brief local anesthesia induced by cocaine. The instrument was later perfected, and the platinum plate replaced with a sharp instrument with glowing blade.

In 1879 Edison built the first incandescent light bulb and this contributed to a new development of endoscopic instrumentation. In fact, a few years later, Max Nitze, in 1886 developed the first cystoscope which made use of the light support devised by Edison.

This tool can be considered the first real cystoscope constituted by an optical system of glass lenses and an electric light source at the distal extreme that were able to ensure a direct vision of the bladder. He also introduced some modifications including the continuing irrigation and evacuation system, and a hole in the tip of the cystoscope to introduce it on a spindle guide. A still unsolved problem remained the excessive heating produced that could lead to serious burns.

In 1897, J. Albarran y Dominguez, a Cuban, presents the so-called "joint of Albarran" to apply to the cystoscope. This will allow the execution of the ureteral catheterization over which the multiple endourological manipulations still in use. Now the progress is unstoppable and George Kelling, in 1901, coined the term "coelioscopy": “I asked myself, how can organs react at the introduction of air? To solve this problem I have devised a method to use an endoscope in a closed abdominal cavity (Koelioskopie)”. This word indicates the technique whereby, this surgeon in Dresden, after obtaining one pneumoperitoneum by passing air through a sterile gauze, was able to explore the abdominal cavity of dogs by introducing a cystoscope. It’s born laparoscopy!

At the end of 1910, HC Jacobaeus, in Stockholm, published in the journal Munchener Medizinische Wochenschrift an article on the use of "laparothorakoskopie" where an endoscopic instrument was also used in the chest. Kelling and Jacobaeus fought the patenternity of the technique and the tools for a long time, even if Kelling was never able to prove to have actually practiced it on humans. In the same year Bertram M. Berheim, of Johns Hopkins Hospital, became aware
of Kelling and Jacobaeus studies, performed the first laparoscopy in the United States using a proctoscope, and called the technique "organoscopy".

In 1912, in Berlin, the Danish surgeon and radiologist Severin Nordentoft presented a paper at the 41st Congress of the German Society of Surgery in which, first, suggested the use of an endoscope similar to the thoroscope of Jacobaeus to diagnose a meniscal tear. He called this technique: Arthroscopy. In 1918, in the now modern Japanese Empire of post Meiji era, the surgeon Kenji Takagi (1888-1963) performed his first arthroscopic attempt on a corpse using a cystoscope, but the attempt fails because of the inadequate instruments. Takagi not gave up and in 1920, built his first arthroscope with a diameter of 7.3 mm without a lens system with a small field of observation. Both Takagi and Nordentoft sought to develop this method because imaging techniques at the time could not see radio-transparency zones as the menisci. Their attempt was primarily diagnostic, not therapeutic. Takagi could never perform, with this difficult clinical application tool, a real arthroscopy on the patient if not on the corpse and in one clinical case: a patient with fistulous tubercular arthritis. Takagi introduced the arthroscope through the fistula, using saline solution to stretch the joint: the first arthroscopy was carried out successfully even if with difficulty due to the articular environment and the access road.

In Europe, in 1921, was published the first work on arthroscopy by the Swiss Eugen Bircher (1882-1956). Bircher was the first to use arthroscopy in surgery. Bircher in his works tried to compare the diagnosis by experimental arthroscopy and by open sky surgery. He noted that the diagnosis was possible and continued his experiments in therapeutic field and using surgical clamps made the first meniscectomy. Initially he used an electric thoracolaparoscope of Jacobaeus for its diagnostic and therapeutic procedures but the thoracoscope gave a very bad view of the knee. Later Bircher developed a double-contrast approach to improve visibility. Bircher after so many failures and instruments' limits gave up endoscopy in 1930, and his works were largely neglected for decades.

The historical importance of Bircher’s work was revalued by Masaki Watanabe when, in 1975, he was handed the document by dr. Norbert Jschwend, a relative of Bircher. Watanabe was excited about this discovery and disbelief on the lack of scientific evolution of arthroscopy in those years.

Unfortunately in that historical period, the sharing of scientific work and the development of medicine, was developed in three large blocks: Europe, United States of America and Japan who worked independently and publications were made in the native language.

In 1920 B.H. Orndoff, internist in Chicago, reported the first series of 45 cases of diagnostic peritoneoscopy, and invented the trocar with a truncated cone tip. In the same period it succeeded a number of innovations including an endoscope with a 135 degrees and a multiple trocar access performed by Heinz Kalk, founder of the German school of laparoscopy.

In the US the first to deal with arthroscopy was Philip Kreuscher (1883-1943) who in 1931 published a work on Illinois Medical Journal about the diagnosis and arthroscopic treatment of meniscal tears. Great was his foresight, in fact he argued that arthroscopy would become widely used in the future. At the same time, in 1931, Michael S. Burman (1896-1974), in the Hospital for Joint Diseases in New York, executes a number of studies on cadavers, using a 3 mm arthroscope and describing the arthroscopic joint anatomy.

In 1933 in Japanese empire continued self development of arthroscopy by the doctor Kenji Takagi, who reported additional clinical results and presented a color arthroscopic movie of 16 mm. and the first color photographs at the 8th meeting of the Japanese Orthopaedic Society.

In 1937, Watanabe was recruited in the army and went to greet his teacher Takagi who told him: "I'm sure the arthroscopy will represent a chapter in future orthopedics treaties." Saburo Iino analyzing arthroscopically cadaver knees expands by water, brought the foundation to run the diagnostic study with the arthroscope. In this article the author recognizes an anatomical element present in 50% of knees examined calling it plica and considering it peculiar of Japanese population. Also Saburo Mizumachi recognized the same anatomical structure in 1948 and recognized it peculiar of Japanese population. Only in 1972 it was called synovial mediopatellar plica by Watanabe and Jo Sakakibara and recognized in populations different from the Japanese.
With World War II arthroscopy sees a stop period and only after 16 years there is a return to publish on arthroscopy. In Italy, the first to speak about arthroscopy were Chini in 1941 and Lucherini in 1946, but the first to perform an arthroscopy was Filippo Vecchione (exactly he executed 10) who used the technique and was inspired by the instruments of the German Vaubel and published his results on the archive of Orthopedics in 1947.

In the second post-war the evolution of arthroscopy was in the hands and minds of Watanabe who in 1958 built the n. 21, which represented the breakthrough for the entry into a new era. In September 1957, during the 7th Congress of SICOT, held in Barcelona, Watanabe introduced the color film titled Arthroscopy causing great interest in the audience. There were many orthopedic clinics who visited in the same year by presenting the same movie and getting the same recognition. The same movie was presented at the Philadelphia Accademy in 2 November 1957 and in 17 November 1957 at the Mayo Clinic in Rochester (Minnesota). In February 1961 Watanabe pulled out under arthroscopic control an osteochondral mobile body from a 25 years woman's knee affected by the outcome of a patellar dislocation. The first case of meniscectomy was performed by Watanabe and Takeda on May 4, 1962. The patient was a boy who had suffered a knee sprain playing basketball. The meniscal flap was recognized, cut at the base and removed arthroscopically. The patient was discharged the same day and after 6 weeks was able to resume sports activities. Pleased and excited by the results, Watanabe decided to operate arthroscopically a professional racer with a partial tear of the anterior horn of the lateral meniscus on 26 July 1967. Again the results were striking. Between 1958 and 1967 at the Tokyo orthopedic clinic were performed 154 knee arthroscopy. Were diagnosed 106 meniscal lesions: in 58 cases they opted for a arthroscopic meniscectomy and in 6 cases performed the arthroscopic surgery. Robert W. Jackson in 1964 on invitation of Abe, who collaborated with him in Toronto, traveled to Japan at the Tokyo orthopedic clinic and knew Watanabe. From it, helped by Hiroshi Ikeuchi who spoke English, he learns the arthroscopic technique. He returned to Toronto in 1965 with the arthroscope n. 21 and began to practice. In 1967 Robert W. Jackson talks about his experience on arthroscopy at the annual meeting of the Association of Academic Surgeons held in Toronto, which will publish the article in 1972. Many colleagues since then went to Toronto orthopedic clinic to assess arthroscopy. In 1968 Watanabe became aware of the development of a 1 mm lens called Selfoc, used as a heat transfer laser by Nippon Sheet Glass Company, located in Amagasaki near Kobe. He went to the office and proposed to the members of the research the development of the arthroscope Selfoc for the study of the small joints. Two years later, in December 1970, the arthroscope Selfoc was ready: 1.7 mm apical diameter and 2 mm at the base, on the portal. This arthroscope has allowed the study of countless small joints not previously assessed by arthroscopic technique. The brightness and clarity of the image were not yet optimal, thus further modifications were made by Olympus Optical Company; they got the arthroscope Selfoscope.

Conclusion

Thanks to the intuition of the Japanese Takagi and Watanabe, orthopedics managed to get out of the reputation of a bloody and violent surgery. Their intuition nowadays is commonly used in clinical and therapeutic practice. The revolution that arthroscopy has brought to Orthopaedics has moved from the knee to the other joints such as shoulder and hip, which are producing excellent results in diseases' treatment.

Essential References:


