Matasaki Watanabe –

HISTORICAL BACKCROUND

Professor Kenji Takagi of Tokyo first applied the endoscopic principles of cys toscopy to the examination of the knee joint in 1918.10 He viewed the tuber-culose knee through a cystoscope, and the clarity of the view encouraged him to design specific instruments for the inspection of joints. The first arthroscope designed by Takagi was a 7.3 mm instrument, available in 1920, which had a lens system similar to the Charrier No. 22 cystoscope. Because its size made it impractical for routine use, he continued to improve it, until, finally, in 1931, he devised a 3.5-mm arthroscope that included a lens system that was suitable for inspection of the smaller joints when they were distended with a saline solution. Cas arthroscopy was first undertaken by Bircher in 1921.1 He reported the results of his findings in knees distended by oxygen or carbon dioxide and examined with a Jacobeus laparoscope. The first writings appeared in the American literature in 1925, when Kreuscher reported on the use of the arthroscope in diagnosing meniscal disorders.7 Fur-ther advances were reported in the American literature when Finkelstein and Mayer reported the results of using punch biopsies under arthroscopic control in 1931.5 In the same year, Burman described an experimental cadaver study of arthroscopic visualization of the hip, knee, ankle, shoulder, elbow, and wrist joints.2 Shortly thereafter, in 1934, Burman, Finkelstein and Mayer reported their findings on arthroscopy and mentioned the significance of the use of the arthroscope for an accurate diagnosis of knee disorders.34 The European medical community had reports from Sommer in 1937, Vau bel in 1938, and Hurter in 1955, in which they described their methods, tech-niques, and findings after using the arthroscope in the examination of joint derangements. 68.9 All of these authors described both techniques and findings, but it was for the Japanese orthopaedic community, under the guidance of Takagi, Watanabe, Takeda, and Ikeuchi, to develop the single- and multiple puncture techniques for performing arthroscopic surgery of the knee. Finkelstein and Mayer had reported their use of the punch biopsy under arthroscopic control in 1931, but it was Takagi who separately described the use of a flexible biopsy punch and cauterizing instrument under arthroscopic control. Passage of the instrument through an arthroscopic sheath was the cornerstone in the development of other instruments.

The Historical Background section of this chapter was contributed by Wesley M. Nottage Masaki Watanabe wrote the section on Arthroscopic Surgery, The Early Years, and Robert C. Bechtol wrote the section on The 0 Connor Years

ARTHROSCOPIC SURGERY

The Early Years

In 1950 I developed a sheath that was intended for use separate from the arthroscope, through which the punch biopsy could be introduced into the joint cavity and brought into the arthroscopic field of vision. The use of this separate sheath was a new idea, and it proved to be an exploitable technique, one that led subsequently to the development of a small knife, scissors, and other instruments that could be passed through the sheath in a sinular fashion. Following the development of these in-struments, removal of loose bodies became a rou-tine procedure. Significant examples of arthros copic surgery in the early stages of its development include the following cases. The first case of true surgery under arthros-copic control was performed on March 9, 1955. Ar-throscopy of a symptomatic knee demonstrated a pedicled oval tumor on the medial part of the su-prapatellar recess (Fig. 1-1). Because the tumor was too big to be removed through the sheath, using arthroscopic visualization, it was held, its base was divided, and it was extracted together with the sheath from the knee joint. The subsequent his-tological diagnosis was that of a partially necro-tized xanthomatous giant cell tumor. On Feburary 22, 1961, an ostcochondral loose body was extracted from a 25-year-old female who had developed a symptomatic loose body follow-ing a patellar dislocation. It was removed under arthroscopic control (Fig. 1-2). I performed my first case of arthroscopic par tial meniscectomy on May 4, 1962. Arthroscopy of a symptomatic knee in a young Japanese man dis-closed a typical L-shaped tear of the medial me-niscus (Fig. 1-3A). A separate sheath was intro-duced into the knee through a small puncture wound, a scissors was passed down into the joint, and the flap was divided at its base. Owing to its

size, the flap cess, and a taneously from iscal fragment.

was passed into the suprapatellar re-Kocher clamp was introduced percu-the medial side to clamp the men-It was then extracted from the joint

without opening the knee (Fig. 1-3B). The patient returned home on foot the same day, and 6 weeks later he had a full range of motion of 0° to 140°. He continued playing basketball. Encouraged by these results, on July 26, 1967, I performed arthroscopy on a runner, which dem-onstrated a partial rupture of the anterior horn of the lateral meniscus (Fig. 1-4A). The medial infra-

2 O'CONNOR'S TEXTBOOK OF ARTHROSCOPIC SURGERY

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Fig- 1-1. A pedicled tumor in the bottom of the Su prapatellar zecess.

Fig. 1-2. A loose body in the suprapatellar cavity.

patellar approach was used for the arthrscope, and surgical instruments were passed into the joint from the lateral infrapatellar approach- The frayed meniscal flap was cut at its base and removed un-der arthroscopic control. A 26-year-old woman with right knee pain underwent arthroscopy in 1970. It was noted that the plica synovialis mediopatellaris had two inser tions (fenestrated shelf), and that the remainder of the joint was normal (Fig. I-B). These insertions of the shelf were divided with scissors introduced through a separate sheath, and the patient's symp-toms resolved completely. Also in 1970, Dr. Hiroshi Ikeuchi of our ortho-paedic clinic succeeded in totally removing a dis-coid lateral meniscus under arthroscopic visualiz-ation.

Overall during the period from 1958 to 1967,

154 knee joints with suspected ments underwent arthroscopy in clinic; 106 meniscal lesions were

internal derange-our orthopaedic noted. Open sur

was performed on 58 of these 106 cases, and roscopic meniscectomy was performed on six cases. The results for those six cases of arthros-copic partial meniscectomy were excellent by com-parison to the results of open meniscectomy. Until 1959, arthroscopy of the knee joint, in-cluding the first case of arthroscopic surgery, was carried out with the #13 arthroscope Because color photographs of the menisci were difficult to ob-tain, several attempts were made lo improve the arthroscope. After working with the trial arthro-scopes #14 to #20, Dr. Takeda and I succeeded in developing the =21 arthroscope, and we wrote of the proper technique for its use in 1960. Through the development of this arthroscope, color pho-tography of the interior of the knee joint finally became possible. This was the arthroscope with which most American pioneers in arthroscopy learned their techniques and practices. Based on the experience we had obtained from multiple arthroscopies, we first published theAflas of Arthroscopy in 1957. Subsequently, based on 800 cases using the #21 arthroscope, we published a second edition of the Atlas of Arthroscopy in 1969. In 1973, I presented the preliminary report on the Selfoc Needlescope," a fiberoptic instrument that has since been refined and manufactured in diameters of 2.2 mm and 1.7 mm. This device has been applied to the examination of small synovial joints, including the shoulder, elbow, wrist, and metacarpophalangeal joints of the upper limb. In the lower extremity, arthroscopic examination has

Fig- 1-3. (A) i -shaped tear of the medial meniscus (right knee joint). (B) Removed flap.

Fi8- 1:4. (A) Partial rupture of the lat eral meniscus (right knee joint). (B) Plica synovialis mediopatellaris with two mal insertions. One insertion is ; cut with intra-articular scissors.

been carried out on the hip, knee and ankle and on subtalar and metatarsophalangeal joints as well. With these developments, ar hroscopic men-iscectomy became a very interesting and exciting field of orthopaedics. In 1970 and 1971 Richard O'Connor visited our clinic to learn o ur expe-riences, and on his return to the United States he wrote often about his efforts in arthroscopic sur-

gery. From his efforts I was convinced nor would be the man to perfect the of arthroscopic menisceclomy, bringing of meniscectomy within the scope of control.

that O'Con-methodology most types arthroscopic

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The O'Connor Years

Inspired by the work and teaching, of Watanabe and his associates in Japan, O'Connor returned to America in 1971 with the keen anticipation of put-ting into practice those skills he had leamed from the Japanese. Takagi. Watanabe, Takeda, and Ikeuchi had used the single-puncture and multi-plc-puncture (or triangulation) techniques for ar throscopic surgery of the knee. Synovial biopsies, intra articular cautery, removal of loose bodies, re-section of tumors, partial meniscectomies, and to-tal excision of discoid lateral menisci had all been achieved under direct vision using the arthro-scope. There were, however, only relatively few of these cases. Although many American surgeons were different, even opposed, to the new approach,

in-two orthopaedic surgeons in North America were al-ready making the use of the arthroscope known and advocating its acceptance when O'Connor re-turned. Interest in arthroscopy had been stim-ulated when Robert Jackson, of Toronto, Canada, began teaching arthroscopy in 1965, after he had been taught the use of the instrument by Watana be, Ikeuchi, and Takeda in Tokyo. In 1971, a paper entitled "Arthroscopy of the Knee Joint (a review

of 150 Delaware, was Joint Surgery. pared nostic ported

cases)" by 5. Ward Casselis, of Wilmington, published in the Journal of Bone and He presented a that

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the accuracy of arthroscopy to other diag-measures. In 1972, Jackson and Abe re-on the role of arthroscopy in the management of disorders of the knee, reviewing their experiences with 200 cases. These authors were using the #21 Watanabe arthroscope. These re-ports significantly increased the interest in arthros-copy in the United States. John Joyce III and Michael i larty organized the first course on Arthroscopy in the United States in 1973 at the University of Pennsylvania in Phila-delphia. The course was repeated in 1974 with fac-uity and other attendees from several countrics. At the close of this meeting the International Ar-throscopy Association was founded, with Watana-be as its first President, Jackson as Vice President, Casselis as Secretary, and O'Connor as Treasurer. In 1975, the American Academy of Ortho-paedic Surgeons began sponsoring instructional courses on arthroscopy and arthrography of the knee under the leadership of John McGinty, of Newton Lower Falls, Massachusetts. Unique plas-tic knee models were devised by Robert Eilert, of Denver, Colorado, to allow surgeons to practice

4 O'CONNOR'S TEXIBOOK OF ARIHROSCOPIC SURGERY

with the arthroscope. These courses were s well accepted that arthroscory became firmly estab lished as a diagnostic tool among, many ortho-paedic surgeons. Meanwhile, as the diagnostic use of the ar-throscope was being established, O'Connor was successiully improving the standard arthroscope and designing an operating arthroscope with the cooperation of the Richard Wolf Medical Instru-ments Corporation. His all consuming gonl was to work out a practical method of doing scecto mies with the arthroscope. In 1974, he began per-forming partial meniscectomies in caret lected cases. Hle made a drawing of each meruscal tear he encountered and began devising a system atic technique for resection of the mobile portion of the meniscus in the various lesions. !e carried sketches of the meniscal tears with him and quite often asked friends their opinions as to which at-tack on the lesion seemed best. Many thought the operative procedures he proposed were imp 55- ble, so advanced was his thinking. Others felt that the notion of partial meniscectomy was fallacio us being contrary to previous custom and leaching In 1975 O'Connor reviewed his cases of partial meniscectomy and found that the early results were encouraging when compared to classical open meniscectomy, with less pain and morbidity, shorter disability, and shorter hospital stay. He then be gan attempting partial meniscectomy on a less se lective basis. At this time he was routinely using the Wolf prototype of his operating arthroscope He believed that as techniques and operating in-struments improved all for menisdi could be treated operatively with the arthroscope. After the Second Congress of the International Arthroscopy Association (Copenhagen) in July 1975, O'Connor took a cottage in Denmark, se questered himself for a time, and wrote several chapters of the book on arthroscopy he was hop-ing to have published. He included an e: ' re chap ter on arthroscopic partial meniscectom . his was also the year that H. R. Eickelaar of the Nether-lands published his thesis on Arthroscupy of the Kree. In early 1976 O'Connor provided Robert W Metcalf of Salt Lake City and myself with ider cal prototypes of the O'Connor operating arthro pe for trial and critical evaluation. Through w ork w ith the operating arthroscope some of the prot ems of meniscal resection were solved. At this time, very few of the accessory instru-ments being used were designed specifically for arthroscopic surgery. Quite frequently instr-ments were borrowed from other surgical special-

tics, or makeshift instruments were used. For ex-ample, although a specific meniscal probe was eventually manufactured, inutially probing was performed using a crochet hook. A breakthrough in arthroscopic surgery was made when it was discovered that cuttings of the meniscus did not have to be removed from the knee with each cut, but could be simply washed out later with no apparent ill effects. After learning this, those doing meriscal surgery removed the wires from their basket forceps. thereby allowing the cuttings to float free in the joint. This simple change in technique saved an enormous amount of operating time. Thereafter, basket forceps were made without the transverse wires underneath the basket. Aware of the need for special instruments. O'Connor set up a machine shop with his assis-tant, Charles Erichsen, in order to modify and redesign some of the instruments being used at that time. The first book on arthroscopy to be published in North America was Arthroscopy of the Knee, the work ol ja kson and D. J. Dandy, published in 1976 This book included a small section on intra-articular surgery with the arthroscope, and it men tion i • n oval of the small loose bodies, biopsies, the use oftra isfixing pins in loose osteochondral fragments and the removal of meniscal tags, as well as the excision of displaced bucket-handle tears of the meniscus. in 1974 O'Connor's book Arthroscopy was pub shed In the preface he wrote, "My purpose monograph is to share knowl-edge and experience with those interested in ar-hroscopy during what I believe to be its wa-tershed period"—a sentence truly indicative of his desire encourage others in this special ficld. The b c k contained a sizeable section on arthroscopic surgery, including the treatment of meniscal tears. bodies, the medial synovial shelf, osteochon-dritis dissecans. intra-articular adhesions. and fi-brous ankylosis. In the chapter on "Partial Men-scectomy" he classified the various tears of the men scus and indicated which were amenable to

partial meniscectomy, niques to be used. in the same year, Lanny I. Jo Lansing Michigan. was developing intra-articular shaver together with corporated Later. Johnson was

and he described the tech-

hnson, of East the motorized Dyonics, In-successful in

w orking out the details of other motorized instru-ments including rotary cutters for meniscectomy. The introduction of motorized equipment revolu-

fionized some of the techniques of arthruscopic surgery, such as meniscectomy and synovectomy. As a result of the now flourishing, interest in this type of surgery and because of a w ide accept-ance by the general public, many other surgeons

turned butions. Robert

to this field and made significant contri-Space here permits naming only a few. Metcalf, of Sait Lake City, simplified some

of the meniscectomy procedures and showed that lateral patellar retinacular release could be done under arthroscopic control. His instructional courses on Arthroscopic Surgery of the Knee are well known. Roherl Carson. also of Salt Lake C ty, de veloped an ingenious thinner, flatter operating ar-throscope. James Guhl. of Milwaukee, Wisconsin, perfected a technique of treating osteor hondritis dissecans by transarthroscopic pinning or bone grafting, Dinesh Palel. of Boston, Massachusetts, became known for his study of the synovial plica, as well as for arthroscopic rescction of sympto-

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medial patellar plicas. Palel is also known

proximal approaches that DeHaven. of Rochester, arthroscopic examination injured knee, a series of

he has described. New York. pop-of the acutely which has led to the performance of meniscus repairs rather than excisions for peripheral lears of the meniscus Robert Stone. of Dallas. Texas, worked out a technique of men-iscoresis under arthroscopic control. Jan Gillquist, of Sweden, popularized the central, or transpatel lar, ligament approach for arthroscopic knee sur-gery and documented the advantages of arthros copy in acutely injured knees. Nils Orctorp. also of Sweden, devised special instruments and did basic research on the meniscal ligamentous com-plex. Hans R. Henche. of Germany. and Ejnar Eriksson. of Sweden, demonstrated the advan-tages of arthroscopy of the knec in a gas (CO2) medium. The first courses on Operative Arthroscopy were organized by O'Connor in 1978. In that year and in 1979 a series of three courses were spon-sored by the University of California al Los An-geles. These meetings were so well attended that O'Connor was encouraged to plan the First Inter-national Seminar on Operative Arthroscopy, which was held in Hawaii in 1979 with a faculty drawn from various countries. The seminar was intended to be an annual program. and the second one was held in 1980. These annual seminars have been continued by the University of California. Lus An-seles (UCLA), but. tragically. O'Connor died on November 29. 1980. a month after the second sem-inar. The first course on Arthroscopic Surgery to

HISTORY OF ARTHROSCOPIC SURGERY 5

be sponsored by the International Arthroscopy AS-sociation was held the next week in Long, Beach, California, and was dedicated to him. Writing of O'Connor, his associate H. Shah riaree said, . he will be long remembered for his courage and integrity and his insistence on the importance of arthroscopic surgery." Certainly it was Dr. Richard L. O'Connors independent thinking, single-minded determination, and, fi-nally, his convincing surgical results that estab-lished arthroscopic knec surgery as a valuable and accepted procedure.

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