Wrist arthroscopy has a rich history, drawing on contributions from around the world. Its foundation was laid in Japan with Kenji Takagi and Masaki Watanabe, who developed the arthroscope and the techniques for arthroscopy. Across several decades they advanced the optic and lighting technology, allowing the miniaturization which made wrist arthroscopy technologically feasible. A safe and standardized technique for wrist arthroscopy was evolved by Terry Whipple, Gary Poehling, and James Roth in the 1980s, and they shared this with their fellow surgeons through courses and publications. The techniques then spread across the world, leading to widespread uptake and exploration of new therapeutic possibilities. The worldwide spread of wrist arthroscopy was accelerated by the European Wrist Arthroscopy Society (EWAS), founded in 2005 by Christophe Mathoulin. The Asia Pacific Wrist Association (APWA), founded by PC Ho in 2015, also extended the progression of wrist arthroscopy. This article brings together this history and tells the global story of its development through the recollections of those involved. The manuscript includes some amazing videos of the early historical arthroscopy. There are also videos of Gary and Terry describing some of their special memories of the early politics, developments, and evolution of wrist arthroscopy.
Introduction

The first substantive attempts at arthroscopy came over a century ago in Japan. Kenji Takagi and Masaki Watanabe might not have been the first arthroscopists, but they took it beyond mere experiments, developing the technologies that now underpin modern arthroscopy. On this platform wrist arthroscopy was born, as pioneers such as Terry Whipple (United States), Gary Poehling (United States), and James Roth (Canada) adapted and translated the existing technology for use in the wrist joint.

This history is deserving of preservation, and that is the aim of this paper. A reflection of the history is beautifully described by Terry Whipple and Gary Poehling, who were interviewed by Gregory I. Bain (Australia) in October 2019 (Fig. 1). Their personal recollections of key moments present a unique insight into the development of wrist arthroscopy over the last half century.

Primordial Endoscopy/Arthroscopy

Arthroscopy was a late evolution of the longstanding experiments with endoscopic techniques, which dated back at least a century earlier to the early 19th century (Fig. 2, Video 1). In Germany in 1806, Philipp Bozzini (Germany) described his "Lichtleiter," a primitive form of endoscope that utilized a beeswax candle for illumination. This was followed by Pierre Salomon Segalas’s (France) attempts in 1826 which used glow worms for illumination and Antonin Desormeaux’s (France) use of alcohol and turpentine spirit lamps in 1853. Somewhat safer designs such as Julius Bruck’s (Poland) diaphanoscope emerged subsequently, which made use of an electric incandescent globe and a water-cooling system. However, the epithet "fire and water contraptions" suggested that they remained quite dangerous. These devices were used to examine the nasopharynx, vagina, rectum, and urinary bladder, and it was not until 1912 that arthroscopy was first described by Severin Nordentoft (Denmark).4

Nordentoft reported on his experiments of arthroscopy, describing the use of a 5-mm scope to examine a knee joint.4 The knee joint was the focus of most early arthroscopy research, and a steady stream of articles from around the world began to be published.5 In 1918 Kenji Takagi (Japan) (Fig. 3A) performed an arthroscopy on a cadaveric tuberculosis knee using a 7.3-mm Charrier No. 22 Cystoscope.5 Within 2 years he used a modified version of this cystoscope for diagnostic purposes in clinical cases6 (Fig. 3B). This was closely followed by the publication of the first clinical arthroscopy report by Eugen Bircher (Switzerland) in 1921 (Fig. 4), and Philip Kreuscher’s (United States) description of the arthroscopic assessment of meniscal injury.8

Another American surgeon, Michael Burman (United States), was the first to describe arthroscopy of joints other than the knee in 1931.9 His case series included more than 90 joint arthroscopies, over 50 of which were of joints other than the knee. Shoulders (25) and hips (20) made up the majority of these, but he also examined the wrist (4) and elbow. Burman reported on the benefits of traction in the wrist joint, finding that its use increased the joint space by...
“as much as 1/8 to 1/4 of an inch.” He also experimented with various gases as well as saline, distilled water, and boric acid solutions for joint distention.

Early arthroscopes were sterilized in chemical baths, while Yung-Cheng Chen (Japan) described the use of formalin gas chambers. Other arthroscopists utilized sterile plastic sleeves. Modern scopes are capable of withstanding repeated autoclave sterilization, and more recent scopes are single use devices.

The Dawn of Therapeutic Arthroscopy

Takagi had an able junior called Watanabe (►Fig. 5A), who continued to experiment and develop new arthroscope designs. By 1959 they had developed the first production arthroscope, the No. 21, which is beautifully demonstrated in this historical video (►Video 2). This arthroscope featured side and direct viewing telescopes, within a 6-mm sheath alongside the tungsten light bulb carrier. The optics of this scope represented a significant advancement, which Watanabe described as if “a human eye has been placed there.” It featured a focal distance from 1 mm to infinity, and a field of vision of 88 degrees in water and 100 degrees in air.

Video 2

History of arthroscopy. This video includes historical videos of early arthroscopy with Masaki Watanabe and Kenji Takagi “Takagi said it was as if a human eye had been placed here.” The father of modern arthroscopy, Masaki Watanabe demonstrates the finer points of the first production arthroscope—Number 21, in 1957. Video of Watanabe performing the first partial meniscectomy in 1962. These historical videos within this video are courtesy of Gary Poehling. Copyright IWAS 2021. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0041-1740304.

Arthroscopy initially found its niche as a diagnostic tool, however, even this was a difficult task. These early arthroscopes were barely fit for purpose, being rudimentary modifications of laparoscopes and cystoscopes. The awkward positioning of the viewing portals, fragile incandescent light bulbs located within the joint, and large diameter resulted in frequent equipment failure. However, it was this fragility that inspired therapeutic arthroscopy when Hiroshi Ikeuchi (Japan) and Watanabe lost a light bulb within the knee joint. Watanabe suggested to his mentee Ikeuchi that he could insert a second arthroscope to the knee joint to locate the lost light bulb, and then used a pair of forceps via a second portal to retrieve it!

The pair realized that they could do much more than just retrieving broken light bulbs and began to experiment with therapeutic arthroscopic procedures. Watanabe undertook punch biopsy (1950), giant cell tumor excision (1955), and loose body removal (1961). In 1957 the publication of the first Atlas of Arthroscopy enabled a wider spread of the
information, with description of technique and images to entice other surgeons to engage in this new technology (Fig. 5B). In 1962, he performed the first arthroscopic partial meniscectomy on a 17-year-old male who had sustained his injury playing basketball.15

**Small Joint Arthroscopy**

The development of small joint arthroscopy relied on the early advances of optics, which then allowed the scope to be introduced into the joint (Fig. 6A). Watanabe’s No. 21 arthroscope had excellent optics, but lens technology of the time limited miniaturization. The earlier No. 11 arthroscope designed by Takagi did have a diameter of only 2.7 mm, but its poor focusing limited its clinical use.16 These early arthroscopes had optics based on those of telescopes, with glass lenses separated by air. A significant step forward was made with the introduction of Hopkins’ rod lens.2 These lenses were longer and allowed far better light transmission while being robust at smaller diameters. A second innovation was the advent of fiber-optic lighting systems, starting with the Nippon Sheet Glass Company’s (Japan) Selfoc technology. This allowed the light to be external to the joint, being transmitted by the fiber-optic cable. The combination of these two advances allowed the production of small diameter scopes with wide viewing angles and clear focus.16

The Selfoc system was first utilized in an arthroscopic in 1970, when the 1.7 mm No. 24 arthroscope was released. This scope is also referred to as the Selfoc scope because of its use of this ground-breaking technology, and in the United States was marketed by Dyonics as the Needlescope. The No. 24 had direct and fore-oblique viewing options, with a viewing angle of 55 and 70 degrees, respectively.11 The lens was of the rod lens design, 134 mm long and just 1 mm in diameter. This was a key breakthrough, but the image in the initial version was flipped. This was corrected with the addition of an Amici prism (two prisms in series) (Fig. 6B). Alongside the original 1.7 mm diameter scope released in 1970, four models up to 3.2 mm in diameter were produced by 1978.11

The small diameter of the No. 24 arthroscope allowed Watanabe to examine 21 wrists joints in 1970 to 1972,11 but the cameras were large and unwieldy. This problem was exacerbated as the arthroscopes became smaller and more fragile, increasing the risk of breaking the scope and injuring the patient. The early cameras were the size of a bread box, but rapidly reduced to the size of a fist. These small chip cameras were much easier to maneuver, and consequently made small joint arthroscopy much more practical.17 The newest scopes, such as the Arthrex Nanoscope, have the camera within the tip of the scope, so there is no need to have brittle rod lenses.

**Early Wrist Arthroscopy**

The 1.7 mm No. 24 arthroscope was the breakthrough that allowed wrist arthroscopy to flourish. Many of the early proponents of wrist arthroscopy used the No. 24 including Watanabe, Chen, and Lanny Johnson (United States).6,10,18 The American Academy of Orthopedic Surgeons surveyed their members in 1978, finding that while over 50% had performed knee arthroscopy, only 6% had attempted arthroscopy of any other joints.18 Watanabe reported 67 wrist arthroscopies including examination of the distal radioulnar joint, using dorsal portals on the ulnar side of the extensor pollicis longus tendon.6 He also used the No. 24 arthroscopic in the metacarpophalangeal joints (39), interphalangeal joints (9), and the thumb carpometacarpal joint.6

Chen described similar dorsal portals in his 1979 paper, in which he reported over 90 arthroscopic procedures involving the joints of the hand and wrist.10 These portals were also dorsally ulnar to the Extensor Pollicis Longus (EPL), which he termed the dorsoradial (between EPL and Extensor Digitorum Communis (EDC)) and dorsoulnar (between EDC and Extensor Digiti Minim) portals. Chen credited Watanabe for his guidance in the area which explained the similarities in their approach to the wrist joint.

**North America—and the 1st Wrist Arthroscopy Course**

The majority of the early development of arthroscopy, was within Japan. In 1964 Robert (Bob) Jackson (Canada) worked...
as a fellow for Watanabe, and later then returned to introduce arthroscopy to North America.\textsuperscript{12} The early introduction of knee arthroscopy created heated debate, as the senior Iconic knee surgeons were comfortable and well trained in open surgery. The new "upstarts" were keen to advance the minimally invasive techniques, but at the ire of their senior colleagues.

In 1970, Captain Gary Poehling (United States) was posted to Japan for military medical service (\textsuperscript{\textit{Fig. 7}}), where he acquired a No. 26 arthroscope for his departmental chair J. Leonard Goldner. He described his early experiences with Goldner who appointed him head of arthroscopy as a first year resident. He was succeeded in this role by Terry Whipple (United States) (\textsuperscript{\textit{Fig. 8}}) in 1975. Whipple worked with Frank Bassett (United States), a leading sports orthopaedic surgeon, and developed arthroscopic surgical techniques for the knee joint.\textsuperscript{19} Some of the interesting aspects of this history are recalled by Gary Poehling and Terry Whipple in the recorded interviews (\textsuperscript{\textit{Video 3}}).

\textbf{Video 3}

Videos of Terry Whipple and Gary Poehling. This is a review of some of the contributions of Terry Whipple and Gary Poehling. It includes videos of their recollections of some of the events. It also includes Leonard Goldner’s decision to make Gary in-charge of arthroscopy upon his return from Japan as only a junior resident. Terry describes Leonard Goldner’s hesitancy about using arthroscopy for therapeutic purposes. Also includes Terry Whipple’s speech, when he was awarded the Life-time Honorary President of IWAS. Copyright IWAS 2021. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0041-1740304.

In 1981, Johnson (United States) published his early attempts at wrist arthroscopy, as part of his comprehensive textbook on arthroscopy.\textsuperscript{18} Johnson described accessing the wrist joint via the anatomical snuffbox (\textsuperscript{\textit{Fig. 9}}), however, it was not clear whether this was an effective or safe approach. This highlights that during this period there was little standardization of a safe technique for wrist arthroscopy.

In 1985, Whipple and Poehling met James Roth (Canada) (\textsuperscript{\textit{Fig. 10}}) at the International Society of the Knee meeting in Salzburg, Austria and discovered their mutual interest in wrist arthroscopy. They had dinner at the Winkler Hotel,
where they devised a plan to introduce the technique to the surgeons of North America (Fig. 11). Whipple would create a teaching model, traction tower, finger traps, and surgical instruments. Poehling would establish a cadaveric teaching workshop for American surgeons, and Roth wrote an academic paper. Whipple enlisted the assistance of his sports fellow, Jack Powell, to perform cadaveric dissections for the development of safe working portals for wrist arthroscopy. They named the radiocarpal portals according to the extensor compartments (Fig. 12) and described midcarpal and distal radioulnar joint portals.

Their systematic approach to research, education, and developing a standardized and safe operative technique has formed the foundation on which wrist arthroscopy has thrived over the past 35 years.

Whipple, Poehling, and Roth were careful to avoid the mistakes that delayed the uptake of knee arthroscopy when it was introduced to North America. They requested the assistance of James Urbaniak (United States), who was President of the American Society for Surgery of the Hand (ASSH) at the time. He wrote to many of the senior hand surgeons in the United States, encouraging them to attend the first wrist arthroscopy course, which took place in Winston-Salem, North Carolina in 1986 (Fig. 13, Video 4). The workshop included video presentations and live demonstrations using Whipple’s teaching model and cadavers. The traction tower and finger traps were utilized, and the named portals were

Fig. 8. Terry Whipple (United States) performed cadaveric dissections with Powell, to determine the named extensor compartment portals we use today. He developed the traction tower and finger traps. These aspects allowed wrist arthroscopy to become safe and standardized. Image courtesy: Terry Whipple.

Fig. 9. Lanny Johnson (United States) demonstrates wrist arthroscopy through the anatomical snuff box. He used a “laceration of the skin only, avoiding superficial branch of the radial nerve” to enter the radio-ulnar joint through the snuff box to assess the wrist. Image courtesy: Johnson 1986 (p.141). 18

Fig. 10. James Roth (Canada) operating with Sports Orthopedic Surgeon Peter Fowler (right), who was Foundation President of ISAKOS 1995–1997. Image courtesy: Graham King.

Fig. 11. Terry Whipple, Gary Poehling, and James Roth at the Winkler Hotel in Salzburg, Austria during the 1985 International Society of the Knee meeting. All three were interested in hand and wrist surgery. They agreed upon a strategy to introduce wrist arthroscopy to the United States: Whipple would develop a teaching model, Poehling organized a course, and Roth wrote a paper. Image courtesy: Gary Poehling.
used for diagnostic and therapeutic wrist arthroscopy. Basic and advanced techniques were taught including TFC debridement, synovectomy, scaphoid fracture fixation, and scapholunate instability stabilization. Bill Bowers, a leading surgeon with expertise in anatomy and surgical techniques reported that the arthroscopic demonstrations had taught him more about wrist joint anatomy than his many years of cadaveric dissections.

The workshop was a strategic masterstroke. Many of the invited senior hand surgeons might not have gone on to integrate wrist arthroscopy into their practice, but the workshop made the benefits clear to all, ensuring junior colleagues could embrace the technique with senior support. Some of those junior colleagues later made significant contributions, including Bill Cooney, Andy Koman (Fig. 13D), Lee Osterman (Fig. 14), Andrew Palmer, and Dan Nagle (Fig. 15).

Consolidation of Technique

The early courses provided a glimpse of the therapeutic possibilities of wrist arthroscopy, but as with knee arthroscopy, it was initially a diagnostic tool. An award-winning paper confirming its clinical efficacy was published by Roth and Richard Haddad in 1986, comparing wrist arthroscopy and arthrography for the diagnosis of ulnar wrist pain. They found that arthroscopy was superior to arthrography for the identification of TFC tears. Wrist arthroscopy quickly became the “gold standard for diagnosis” for wrist joint pathology.

Diagnostic wrist arthroscopy had become possible following Watanabe’s development of smaller arthroscopes in the early 1970s, but it would require the miniaturization of instruments to allow therapeutic wrist arthroscopy to flourish. Whipple, Poehling, Roth and many others undertook to develop smaller instruments suitable for wrist arthroscopy, based on knee and shoulder arthroscopy instruments available at the time.

Video 4

First Wrist arthroscopy workshop. Terry Whipple and Gary Poehling outline the battleground that faced younger knee surgeons who were keen to integrate arthroscopic techniques into their practice. “Why would anyone want to look through a keyhole when you could walk through the front door.” Gary Poehling, Terry Whipple, and James Roth met at the International Knee Association meeting in Salzburg, Austria in 1985. They realized they were all hand and sports surgeons, and created a plan to develop, teach, and standardize wrist arthroscopy. They described how they set up the first Wrist workshop, to avoid the political issues that plagued knee arthroscopy. Copyright IWAS 2021. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0041-1740304.
Fig. 13  Attendees at the first wrist arthroscopy workshop at the Bowman Gray School of Medicine, Winston Salem, United States 1986. This was the start of the new era, which enabled wrist arthroscopy to be promoted and developed in an organized way. (A) Photograph, (B) diagram of names of attendees, (C) the faculty were (from the left), Gary Poehling, Bill Bowers, Andy Koman, Terry Whipple, and Jim Roth. (D) Attendee include Leonard Goldner (center bottom) who performs his first wrist arthroscopy. A young Bill Cooney (center top) and Andy Koman (right) look on. Both later made significant contributions to the development of wrist arthroscopy. Image courtesy: Gary Poehling.
others, but suitable miniaturized hand-held and powered instruments were developed. Whipple published the first wrist arthroscopy textbook in 1992, a significant step in the globalization of the technique. It was quickly sold out, demonstrating the enthusiasm for the technique. “Arthroscopic Surgery: The Wrist” (Fig. 16), was a comprehensive publication, outlining the operative equipment and techniques, and numerous basic and advanced therapeutic procedures. Whipple described many of the procedures that were demonstrated in their early wrist arthroscopy courses, including arthroscopic-assisted distal radius fracture reduction and fixation, synovectomy and many more. But his biggest contribution was to develop a standardized safe method of performing wrist arthroscopy, and to be part of the team that taught it to the world (Video 5).

Poehling developed new techniques, including the in-side out Tuohy needle technique to repair peripheral TFC tears. He also became President of ISAKOS and Editor and Chief of the Journal of Arthroscopy, a position he held for 23 years.

Roth described a motivation to reduce the need for an arthrotomy, as it led to a slower recovery and poorer prognosis. He described the “ectomy” procedures such as proximal row carpectomy. Randall Culp (United States) (Fig. 17) also described a technique for arthroscopic proximal row carpectomy and highlighted the importance of minimizing complications of wrist arthroscopy.

As the therapeutic possibilities blossomed, so too did the need to understand the anatomy of the wrist. Steve Viegas (Fig. 18) and Richard (Dick) Berger (Fig. 19) made many contributions to the understanding the ligaments of the wrist and distal radioulnar joints and more.

In 1995, Osterman published the first in series of papers describing the arthroscopic resection of dorsal wrist...
ganglion, and subsequent larger series in 2003. He made many contributions, including arthroscopic techniques for TFC debridement, carpal instability, proximal row carpectomy, and distal radius fractures. Osterman made many other contributions, including the Annual Philadelphia Hand Surgery Symposium.

To Europe and Beyond

Once the techniques were well established, they started to spread to other parts of the world. The senior academic surgeons taught all over the world. There were many books from many authors, including one from John Stanley and Philippe Saffar. Saffar was Editor in chief of the Journal “Chirurgie de la Main” from 2001 to 2008, and an important mentor for Christophe Mathoulin.

Mathoulin (France) made important contributions to the understanding of the anatomy of the scapholunate interval, which resulted in the EWAS classification of scapholunate instability. Mathoulin developed techniques for scapholunate capsulodesis and described further cases of intra-articular distal radius fractures that had been treated via arthroscopic reduction and fixation. His most significant contribution was creating and developing EWAS, which shared wrist arthroscopy with the world.

Guillaume Herzberg (France) has been instrumental in advancing our understanding of perilunate injuries, initially reporting on 157 cases of perilunate dislocation in 1993. This was followed, 20 years later, by his description of PLIND: perilunate injury, not dislocated, which highlighted the essential role of wrist arthroscopy for accurate diagnosis of these injuries. The Lyon wrist course, development of systematic wrist scores, and treatment of wrist injuries have been other major contributions.

By 1995, research into the use of arthroscopy/endoscopy in areas around the wrist, including soft tissue compartments of the forearm was increasing. One of the earliest described and most popular techniques was the endoscopic carpal tunnel release. The procedure was independently described in 1989 by Ichiro Okutsu (Japan) and James Chow (United States), and John Agee (United States) in 1992.

Building on these endoscopic carpal tunnel releases were procedures for other nerve compression syndromes of the...
upper limb. Endoscopic techniques for pronator teres syndrome, radial tunnel syndrome, and Guyon’s canal release have all been described. Most popular is Reiner Hoffmann’s (Germany) technique for endoscopic cubital tunnel release. Other endoscopic procedures around the wrist have included tendon transfers, bursectomy, fasciotomy, vessel, tendon, and bone grafts all developed. Arthroscopic pisiform excision has also been described as well as endoscopic techniques for the management of compartment syndrome and intersection syndrome and release of the first extensor compartment.

Arthroscopic techniques for the management of scaphoid fractures have been described by Joe Slade (United States)
In 2001, Slade described a dorsal approach for arthroscopic reduction and percutaneous fixation of scaphoid fractures, and Ho made a further contribution in 2011 by publishing the technique of arthroscopic bone grafting in scaphoid nonunion. Ho also described procedures for volar ganglion resection and limited wrist fusion, and wrist arthroscopy under portal site local anaesthesia without tourniquet and sedation. Stiffness is a common complication in the wrist following trauma and surgery. Riccardo Luchetti (Italy) reported that arthroscopic wrist arthrolysis was an effective treatment. In 2006, Gregory I. Bain (Australia) described the in-side out volar portal, arthroscopic debridement of STT arthritis, ulnar styloid impaction, intra-osseous ganglions, and also, the assessment and arthroscopic classification for the management of Kienbock’s disease was first published. This diverged from but complemented Lichtman’s existing radiological classification.

After early experiments by Chen and others with various gases and fluids for joint distention, saline became the norm.
However, in 2007 Francisco (Paco) del Piñal (Figs. 29, 30) published his technique for dry wrist arthroscopy. Piñal also contributed techniques for the arthroscopic management of distal radius fractures and malunions, and wrote on distal radius fractures, and ulnar sided wrist pain in microsurgery and EWAS textbooks.

Another of Pinal’s contributions has been the important correction of the interpretation of chronic regional pain syndrome (CRPS). TFCC injuries and wrist arthroscopy have a long history, its examination being one of the key moments in the first wrist arthroscopy course in 1986. Since then, numerous studies have been published, advancing our understanding of TFCC tears and their management. Toshiyasu (Toshi) Nakamura (Japan) (Fig. 31) refined our understanding of TFCC anatomy, and how it worked as a hammock, and the importance of the foveal fibers, through his anatomical and clinical studies in 2001. There were important classification contributions by Andrew Palmer, Andrea Atzei (Italy) (Fig. 30) and Riccardo Luchetti (Fig. 26). Many arthroscopic TFCC stabilization techniques have been described, including Whipple’s outside-in capsular repair, Poehling’s inside-out Tuohy needle technique, Nakamura’s transosseous outside-in technique, and Atzei’s technique of using suture anchor. PC Ho and Luchetti further developed arthroscopic techniques to anatomically reconstruct the radio-ulnar ligaments with tendon graft through bone tunnels for chronic DRUJ instability.

Scapholunate instability is another condition that may be managed by arthroscopic means. Whipple made one of the early contributions in 1995, when he described the multiple K wire arthrofibrosis technique. A year later William Geissler (United States) (Fig. 33) published an arthroscopic classification for scapholunate instability. Tommy Lindau (Sweden) (Fig. 34) reported on the natural history of TFC and scapholunate ligament tears in the context of distal radius fracture, while Mathoulin described an arthroscopic scapholunate capsuloplasty technique. Giorgio Brunelli (Italy) described an open dorsal tenodesis to prevent dorsal subluxation of the proximal scaphoid, which started a revolution of reconstructive techniques to stabilize the scapholunate interval (Fig. 26). Marc Garcia-Elias (Spain) (Fig. 35) has contributed a comprehensive understanding of the anatomy, classification, and open management of scapholunate instability. PC Ho and Fernando Corella (Spain) further pushed the limit on arthroscopic anatomical front-back reconstruction of the scapholunate ligament complex using tendon graft with different surgical designs. On the ulnar side of the wrist, Jan-Ragnar Haugstvedt’s (Norway) (Fig. 32) developed techniques for lunotriquetral ligament tears.
David Slutsky (United States) developed several arthroscopic volar portal techniques and edited many textbooks (►Fig. 36).\textsuperscript{31,103–105} However, his biggest contribution is the establishment of the Journal of Wrist Surgery in 2012, as the Foundation Editor. This will remain an important legacy to wrist surgery.

There are so many other contributors to the field of wrist arthroscopy. These include Tyson Cobb (United States) (►Fig. 37),\textsuperscript{106} Alejandro Badia (United States),\textsuperscript{107,108} Max Haerle (Germany) (►Fig. 38),\textsuperscript{109} Peter Jorgsholm (Denmark),\textsuperscript{110} Buddy Savoie (United States) (►Fig. 39),\textsuperscript{96} Arnold-Peter Weiss (United States) (►Fig. 40),\textsuperscript{111} and Lars Aldofsson (Sweden) (►Fig. 41),\textsuperscript{112} Luc De Smet (Belgium)\textsuperscript{113} Min-jong Park (Korea),\textsuperscript{114} and Jui-tien Shih (Taiwan),\textsuperscript{115} and the list is not exhaustive.

Fig. 31  Toshi Nakamura (Japan) (A) first meeting with PC Ho in Hong Kong in 2002 (Image courtesy: PC Ho). (B) Dr Nakamura is the current editor of the Journal of Wrist Surgery. He has also contributed to our knowledge of anatomy of the triangular fibrocartilage, including how it works as a hammock, which he demonstrates with ease. Images courtesy: Toshi Nakamura.

Fig. 32  Jan-Ragnar Haugstvedt (Norway) celebrates his Norwegian heritage. He developed techniques for the management of ulnar-sided wrist disorders, including TFC tears and lunotriquetral instability. He has also been actively involved in the leadership of EWAS and IWAS. Image courtesy: PC Ho.

Fig. 33  William Geissler (United States) development of the arthroscopic scapholunate instability classification and arthroscopic management of sports injuries. He was a former sports fellow of Terry Whipple and Richard Caspari. Image courtesy: William Geissler.

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Wrist Arthroscopy Societies

An outline of some of the significant events are presented in the timeline. One of the first European upper limb arthroscopy course was organized by Luigi Pederzini and Riccardo Luchetti in 1990 (Fig. 42). In 1999 Riccardo Luchetti and Andrea Atzei (Italy) created the Wrist Group of the Italian Society for Surgery of the Hand, which had its 1st meeting in Verona, with guest speaker Alex Badia (United States) (Fig. 43).

In 2005 Christophe Mathoulin founded the French organization—Groupe European pour l’arthroscopie du poignet (GEAP). This was later changed to GEAP-EWAS and finally to European Wrist Arthroscopy Society (EWAS). It held its first cadaveric workshop in Strasbourg, France (Fig. 44). EWAS progressively developed professionally run cadaveric courses all over the world. They also created quality educational books, supported research and a website. EWAS obtained support from Terry Whipple, and often referred to him as the Godfather of Wrist Arthroscopy (Fig. 45).

Leung-kim (LK) Hung and PC Ho started the Hong Kong wrist arthroscopy course in 1997, initially for surgeons from local and Mainland China. In 2008 Ho succeeded as the course director and transformed the course into an international one. He later founded the Asia Pacific Wrist Association (APWA) in 2015. Since then, APWA conducted annual congresses, supported regional courses and a travelling fellowship (Fig. 46).
International Wrist

What has become clear is that wrist arthroscopy had very humble beginnings, evolving from the primitive “fire and water endoscopy contraption” to what we have today. There are some people who stand out having made such impressive pioneering works. These include Takagi, Watanabe, Whipple, Poehling, Roth, Osterman, Mathoulin, and Ho. Clearly, there are many others who have also made significant contributions.

Wrist arthroscopy is now at a global level, with many international meetings and courses all over the world, including at the Mayo Clinic (Fig. 47), Lyon (Fig. 23), Copenhagen, Rotterdam, Lukang, Shanghai (Fig. 48), Beijing, Singapore and São Paolo, and so on. Many of these are under the banners of EWAS or APWA and being supported by both EWAS and APWA, who are often working together, sharing faculty, and with similar goals (Fig. 48).

In line with this globalization, in 2019 EWAS evolved into IWAS (International Wrist Arthroscopy Society). IWAS honored Terry Whipple and Christophe Mathoulin by making them both Honorary Lifetime Presidents (Fig. 49). Eva-Maria Baur (Germany) became the Founding President of IWAS (Fig. 50).

With the Covid-19 pandemic, unfortunately all wrist courses ceased. Both IWAS and APWA have continued their education mission with on-line webinars. IWAS and APWA now have co-badged webinars, to enable the knowledge and techniques to be expanded to the global audience.
Fig. 41 Lars Aldoffsson (Sweden) was an early leader of wrist arthroscopy in the Nordic countries. He developed the concepts of arthroscopic management of synovitis of the wrist. Image courtesy: PC Ho.

Fig. 42 James Roth and Luigi Pederzini (Italy) together at the first Italian upper limb arthroscopy course in 1990. Image courtesy: Luigi Pederzini.

Fig. 43 Andrea Atzei and Ricardo Luchetti established the Wrist Group of the Italian Society for Surgery of the Hand in 1999. This photo of the 3rd meeting. From left Riccardo Luchetti, Christophe Mathoulin (Guest Professor), Andrea Atzei, Borelli Pierpaolo, and Del Croix Luca. Image courtesy: Ricardo Luchetti.
Fig. 44 The first EWAS course in Strasbourg in 2005. Christophe Mathoulin in front with Riccardo Luchetti. Image courtesy: Christophe Mathoulin.

Fig. 45 Terry Whipple (front and center) a pioneer of wrist arthroscopy is surrounded by past and future presidents of the EWAS in 2013, at the IRCAD-EITS center in Strasbourg, France. From left to right standing: past presidents: Didier Fontes (France), Riccardo Luchetti (Italy), Francesco de Piñal (Spain), Tommy Lindau (Sweden/UK), Toshiyasu Nakamura (Japan), Max Haerle (Germany), and David Slutsky (United States), with upcoming presidents Andrea Atzei (Italy) and Pak-Cheong Ho (Hong Kong). Front row (kneeling): Founder of the EWAS, Christophe Mathoulin (France) and secretary general, Jan-Ragnar Haugstvedt (Norway). Image courtesy: Christophe Mathoulin.
Timeline

Primordial Endoscopy and Arthroscopy

1806 Philip Bozzini (Germany) developed “Lichtleiter” — first endoscopy, illumination, beeswax candle.2
1853 Antonin Desormeaux (France) developed “gaso-gene” — alcohol/turpentine spirit lamp endoscope.3
1867 Julius Bruck (Poland) developed “diaphanoscope” — water cooled electric incandescent globe. The “fire and water contraption.”3
1912 Severin Nordentoft (Denmark) reported arthroscopic examination of the knee joint.4
1918 Kenji Takagi (Japan) performed arthroscopy on a TB knee using a 7.3-mm cystoscope.5
1921 Eugen Bircher (Switzerland) published the first clinical arthroscopy report.7
1931 Michael Burman (United States) publishes the first report of wrist arthroscopy.9
1957 Masaki Watanabe’s (Japan) Atlas of Arthroscopy (1st Edition) published.14
1964 Robert (Bob) Jackson (Canada)—Watanabe fellow introduced arthroscopy to North America.12
1968 Robert (Bob) Jackson presented first arthroscopy course for AAOS.

Development of Small Joint Arthroscopy

1970 Masaki Watanabe developed the 1.9-mm No. 24 Arthroscope, for small joints.11
1972 Gary Poehling took Watanabe No. 26 arthroscope to United States and began role as Head of Arthroscopy.
EWAS/IWAS has been instrumental in bringing together the teaching and collaboration at a truly international level. This photo from the APWA Shanghai Wrist course includes PC Ho, Wendong Xu (China), Christophe Mathoulin, and Jan-Ragnar Haugstvedt. Image courtesy: PC Ho.

Photograph of Terry Whipple at the Inaugural AGM of IWAS in Berlin in 2019. He is responding to being awarded Lifetime Honorary President of IWAS. Part of his inspiring speech is reproduced in Video 3. Jan-Ragnar Haugstvedt, Outgoing Secretary General of EWAS is chairing the meeting.

Eva-Marie Baur (Germany) the Foundation President of IWAS in 2019. Image courtesy: Eva-Marie Baur.
1979 Yung-Cheng Chen (Japan) reported No. 24 arthroscopy of 90 wrist/finger joints.10
1979 Stryker Chondrotome developed to mechanically resect soft tissue.11
1981 Lanny Johnson described a technique for wrist arthroscopy using an anatomical snuffbox portal.18
1984 Terry Whipple and Jack Powell employed cadaveric dissections to define safe arthroscopy portals, and advocated use of traction tower and finger traps.20
1986 Terry Whipple, Gary Poehling, and James Roth organized first wrist arthroscopy course at Winston-Salem, United States.
1986 Terry Whipple (United States) published paper on Techniques of Wrist Arthroscopy.20

Globalization of Wrist Arthroscopy

1989 James Chow (United States) described a technique for endoscopic carpal tunnel release.61
1990 Luigi Pederzini and Riccardo Luchetti (Italy) organized first Italian upper limb arthroscopy course with James Roth (Canada) (► Fig. 42).
1997 PC Ho (Hong Kong) organized first Hong Kong Wrist Arthroscopy Course.
1999 Riccardo Luchetti and Andrea Atzei (Italy) created Wrist Group of the Italian Society for Surgery of the Hand, first meeting in Verona.
2005 Christopher Mathoulin (France) founds EWAS, with first cadaveric workshop in Strasbourg, France. Foundation President Christian Dumontier (France).
2007 Francisco del Piñal (Spain) reports dry wrist arthroscopy technique.80
2008 Guillaume Herzberg organizes first Lyon Advanced Wrist Arthroscopy Course.
2012 David Slutsky (United States) Inaugural Editor-in-chief, Journal of Wrist Surgery.117
2015 PC Ho (Hong Kong), Foundation President of Asia Pacific Wrist Association (► Fig. 46).
2019 EWAS evolves into IWAS. Terry Whipple and Christophe Mathoulin become Honorary Lifetime Presidents.55 Eva-Marie Baur (Germany) Foundation President (► Fig. 50).

Conflict of Interest
None declared.

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Gregory I. Bain, Gary Poehling and Andrew Baker have no conflicts of interest to declare. Terry Whipple holds patents for a fracture reduction/fixation guide, and is a Director of Orthopaedic Research of Virginia.

All videos provided were recorded, edited, and collated by Gregory I. Bain. All the videos are donated to the International Wrist Arthroscopy Society (IWAS) by Gregory I. Bain, Terry Whipple, and Gary Poehling. All the videos remain the property of IWAS.

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History of Wrist Arthroscopy

Bain et al.

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