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Current Concepts on Arthroscopy, Knee Surgery & Orthopaedic Sports Medicine

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INTERNATIONAL SOCIETY OF ARTHROSCOPY, KNEE SURGERY & ORTHOPAEDIC SPORTS MEDICINE • 1995 •

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in this issue

International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine

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OFFICE MESSAGE

2020 A Year of Challenges & Opportunity

2020 has been a challenging year for the entire world. ISAKOS understands the hardships our members are facing during these unprecedented times. As we navigate this period of uncertainty together, ISAKOS' top priority is to ensure that our members around the world have access to educational resources that can help you and your career.

With this in mind, ISAKOS recently started the brand new ISAKOS Webinar Series. Live webinars are presented by the ISAKOS Committees and feature world-renowned faculty discussing a variety of current trends and techniques. Some of these are offered in collaboration with ISAKOS Partner Societies, to extend the reach of this content. For the schedule of upcoming webinars, please visit isakos.com/webinars. Members are also able to view webinar recordings on ISAKOS Global Link — a benefit included in ISAKOS membership. In response to the COVID-19 pandemic, Global Link was offered complimentary to non-members through August 31. Non-members are now eligible to subscribe annually to Global Link or become an ISAKOS member to continue access.

ISAKOS has also recently launched the official ISAKOS Thought Leaders Blog — an initiative from the ISAKOS Communications Committee. Read the latest blog articles from ISAKOS Thought Leaders around the globe — the first post regarding COVID-19 is live on isakosblog.com.

The *Journal of ISAKOS* is also promoting new offerings for 2020. *JISAKOS* recently revitalized its podcast series, hosted by *JISAKOS* Social Media Editors, Emmanouil Brilakis from Greece and Andreas Voss from Germany. Subscribe in Apple Podcasts, Google Play or follow *JISAKOS* on SoundCloud. Also, to commemorate ISAKOS' 25th anniversary this year, *JISAKOS* is selecting the best papers published through the end of 2020. Winners will be revealed in early 2021 and recognized with a $1,000 prize.

ISAKOS' mission of offering education is now more important than ever. ISAKOS is expanding efforts to provide accessible and relevant education to surgeons around the world. Your support ensures that the Society is able to fund and implement education and research initiatives created to support the needs of surgeons worldwide. Donations to the Annual Fund or Godfather & Godmother initiative have an instant impact on the Society's ability to carry out our mission, help us plan for the future of the Society, and ensure that ISAKOS strategic initiatives become a reality. To donate to ISAKOS, please visit isakos.com/donate.

The health, safety, and well-being of our members and the orthopaedic sports medicine community is our highest priority. We look forward to welcoming you to future ISAKOS learning opportunities, including the new ISAKOS Webinar Series plus the 2021 ISAKOS Congress now scheduled for November 27 to December 1 in Cape Town, South Africa.

We miss our colleagues and **can't wait to see you!**

Difficult Times for All

In mid-March of this year, here in New York City, our hospital suddenly stopped our regular routine of outpatient visits and surgery and we transformed ourselves from an orthopaedic hospital into a COVID-19 hospital. While doing so, we continued to provide care for emergency orthopaedic patients, such as open reduction and internal fixation of fractures. Our ambulatory surgery operating room floor was transformed into an Intensive Care Unit. Walls were constructed to separate the intubated patients that were accepted from other local hospitals that were beyond their capacity. A few weeks later, in early April, there did not appear to be a clear end in sight. However, a few weeks after that, we began to see a light at the end of the tunnel and we expanded our operations from only "emergency" cases to "urgent" cases in early May. Our hospital re-opened for elective surgery in mid-June. To my surprise, doing surgery in the COVID-19 era has felt relatively normal. However, the crisis has had a massive impact on our community. I know many people who contracted the virus and some who perished. I also recently saw a patient who I operated on earlier this year, prior to the pandemic, who months later contracted the virus. He required hospital admission and told me that while admitted to a local hospital, he watched three men pass away while lying in hospital beds right next to him. Several doctors in my hospital got sick from the virus and a respiratory therapist who worked at our hospital died from the disease.

It has been a very challenging time in New York, as well as for the rest of the country. At the time of this writing, the number of cases and deaths is unfortunately rising precipitously across the southern United States, for largely preventable reasons.

In addition to the Coronavirus, there has been great civil unrest across the United States due to the killing of black Americans, including George Floyd, Breonna Taylor and Rayshard Brooks. Unfortunately, all were defenseless at the time of their killing by police officers. This has led to an outpouring of outrage and protests across the country, as well as a demand for change.

These problems are not limited to only New York or America. The entire world has gone through an unprecedented hardship over the past few months and every ISAKOS member has been affected to some degree. I hope that our members and their families have made it through this global crisis safely, and I also hope that with an improved situation worldwide, we can meet in person at our 2021 ISAKOS Congress in Cape Town, South Africa with the suffering behind us. I also hope that we can learn from the pain I describe above, to make the world a safer and better place in the future.

Robert G. Marx, MD

ISAKOS Newsletter Editor 2019–2021

ISAKOS recognizes the global movement for eliminating racial discrimination and injustice around the world. As a true global society, ISAKOS has always maintained unequivocal support for the need for, and the unquestionable value in, diversity in race, culture, and gender, and unconditionally supports those around the world who continue to fight towards this important goal for the benefit of all.

"No one is born hating another person because of the colour of his skin, or his background, or his religion. People must learn to hate, and if they can learn to hate, they can be taught to love, for love comes more naturally to the human heart than its opposite."

– **Nelson Mandela** (1994)

JOURNAL OF ISAKOS
Joint Disorders & Orthopaedic Sports Medicine

Some Facts and FAQs about *JISAKOS*

In my first *JISAKOS* Editor-in-Chief's Message, I answered some frequently asked questions such as: What can *JISAKOS* do that the others have not already accomplished? Can *JISAKOS* keep me on the right track? Will my article be registered in PubMed? Is my case report worth publishing? Is my manuscript good enough? In this second message, I will address the difference between traditional publishing, online-only publishing, the hybrid model, and Open Access (OA).

New Journal Models

The traditional model of academic publishing is facing progressive competition. The publishing environment is changing, and revenues are slowly but progressively eroding. Alternative measures of research impact go beyond counting citations (Impact Factor) and consider downloads, social media activity, and other indicators. Open Access journals, preprint archives, and research data collections make it increasingly easy for researchers to bypass traditional publishing. Government agencies and other funders increasingly are requiring that research and publication data resulting from grants that they supply be made publicly available. **Plan S** is an initiative for open-access scientific publishing that was launched in 2018. The plan requires scientists and researchers who benefit from state-funded research organizations and institutions to publish their work in open repositories or in journals that are freely available to all by 2021. During a transition period (until 2023), publishing in a hybrid journal that is covered by a transformative agreement to become a full open-access venue will remain permissible.

Traditional Publishing Model

In the traditional publishing model, anyone can submit an article and submission is free of charge. The journal is published both in a print edition and online. The online version is typically considered the "journal of record" as it is published "first." In addition, some publishers and societies have a more robust online version of the article and print a shorter version, perhaps without data detail, to save space and printing costs. If the journal is associated with a society, it is customary that members of the society get free access to the journal as a benefit of membership. Otherwise, one must be a subscriber for access or pay to view individual articles. In this model, revenue is typically acquired from selling subscriptions to academic and medical institutions as well as to non-member individuals, article pay-per-view fees, and advertising. In the past, article reprints and industry-sponsored special issues (supplements) were also a source of income, but those sources tend to be less popular now for a variety of reasons. Some journals charge a "publication fee" per printed page (although such fees are falling out of favor as more journals opt out of print). Similarly, journals can charge a fee to publish color figures; however, the expense of publishing color figures is related to the print process, and, as more journals go digital, they are no longer charging such fees or are collecting fewer fees (e.g., some journals offer authors the option of printing a figure in black and white but using color in the online version of the article at no additional charge). Copyright is typically retained by the journal, but some journals give authors certain rights to post and distribute content. Commercially published journals often do not give authors much in terms of article copyright in this traditional model.

Online-Only

Some organizations only distribute the journal online (not in print); such journals are known ad "online only" publications. The reasons for moving to the online-only model are that fewer people are reading print, print is expensive, and advertising is dwindling, meaning the print edition is a greater expense burden. For international organizations, sending out print editions is often problematic because mailing systems are slow and the journals are prone to loss or damage. For a society-based journal such as *JISAKOS*, it is customary for members of the society to receive free online access to the journal as a member benefit.

Hybrid Model

Some journals, including *JISAKOS*, still maintain a traditional publishing model but allow authors to pay a fee to make an article Open Access; journals published under this model are known as "hybrid journals." However, the Plan S Coalition, which is made up of major funders such as WHO, Gates Foundation, Wellcome Trust, European Research Council, and many others, are now requiring recipients of research grants to publish their research only in true full Open Access journals by 2021; hybrid journals are not acceptable under Plan S.

Open Access (OA) Model

In OA journals, submissions can come from anyone and there is typically an "Article Processing Charge" (APC) that authors must pay. Some funding bodies account for these fees in their research grants, and some (but not all) institutions have APC funding available for employees who publish unfunded research in OA journals. Otherwise, authors must pay out of pocket in order to have their article published. Distribution is typically online only. There is no "print issue" of the journal. Sometimes, a "print on demand" print version will be available, but the reader must pay separately for this service. The content is freely available to everyone rather than only to subscribers or members. One potential concern with society-based journals is that if all content is made freely available upon publication, then the society loses the member benefit of members getting access to the journal. OA journals generate revenue through the APCs that they charge to authors. Many OA journals have a system by which authors from poor or underdeveloped countries — or even all members of the Society — can apply for a waiver of the fees. Some OA journals with high readerships are able to sell advertising if they have enough traffic to attract advertisers. Several types of copyright license are typically given by Open Access journals, with some licenses being more restrictive than others. In the most liberal license offered, anyone can use, modify, distribute, and make derivatives of the material, even for commercial purposes, as long attribution is given to the original author(s) or owner. More often, a licence is offered in which the work can be shared or distributed if attributed, but not commercially.

Advantages and Disadvantages

Each of these models has advantages and disadvantages. The greatest benefit of OA is that it enables the results of scholarly research to be disseminated more rapidly and widely. More people can read the results, including those who would otherwise not be able to access that information because of financial restrictions. The better visibility and discoverability helps citations and the impact of a journal (as measured with the Impact Factor). Industry has a broad access to the most recent science, which can be built upon. OA is environmentally friendly, involves lower production costs, and has a shorter publication timeline. It is generally expected that we will need to go there at some point in time. The main disadvantage is that the authors must pay in order for their manuscript to get published.

JISAKOS

OA publishing has begun to influence research in orthopaedics in recent years, although perhaps less decisively than it has influenced other fields. Some journals have created a second OA journal and have maintained the hybrid model for their flagship journal. Currently, *JISAKOS* is published according to the hybrid model. This means *JISAKOS* is available both in a print edition and online and we allow authors to pay a fee to make an article Open Access. We have seen a rise in OA articles. In 2019, 4 (10%) of the 42 articles that we published were OA, compared 2%-5% of the articles published in the preceding years. A recent survey among ISAKOS members revealed that the majority of our members access our journal online.

The Future

New forms of journals are moving beyond recreating paper on a screen. Video articles, editorial comments, multimedia, apps, and interactivity are all emerging as alternatives. ISAKOS can play an increasingly important role in the development of alternatives to traditional publishing. Just as digital technologies shifted music sales from albums to singles, so could emerging technologies and services unbundle journals and make it easy and profitable for researchers to offer articles and papers without the approval of an established publisher. Researchers will face additional challenges in keeping up with developments in their field as publication options multiply. *JISAKOS* could play an important role in content curation. Apart from being an important resource for our field, *JISAKOS* also should remain a member benefit. The recent members survey already positioned *JISAKOS* as the main asset for the Society. The journal plays an increasingly important role and attractor of new members.

Prof. Dr. C. Niek van Dijk, MD, PhD
NETHERLANDS

Editor in Chief, *JISAKOS*
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An Invaluable Resource for the Orthopaedic Community

JOURNAL OF ISAKOS
Joint Disorders & Orthopaedic Sports Medicine

The *Journal of ISAKOS* (*JISAKOS*) publishes high-quality peer-reviewed articles from the international community of orthopaedic surgeons and sports medicine physicians. *JISAKOS* articles provide highly relevant, state-of-the-art information to help busy sports medicine professionals understand how to achieve the best results for their patients.

Key fields of interest include:

- Orthopaedic sports medicine
- Sports traumatology
- Arthroscopy
- Open and arthroscopic knee surgery
- Degenerative joint disease
- Arthroplasty
- Foot and ankle
- Hip
- Elbow and wrist
- Sports injury rehabilitation
- Team coverage

To provide readers with the most relevant information, *JISAKOS* publishes several different types of articles, including Original Research articles, Current Concepts Reviews, Systematic Reviews and Meta-Analyses, State-of-the-Art Reviews, "The Classic" articles, Case Reports, and Technical Notes. Detailed descriptions of each article type can be found on the ISAKOS website at **jisakos.bmj.com/pages/authors**. A selection of recent and upcoming *JISAKOS* articles representing a wide range of topics and article types are summarized below. For the full articles, please visit **jisakos.bmj.com**.

UPPER EXTREMITY

SHOULDER

Arthroscopic Anatomic Glenoid Reconstruction for Anteroinferior Shoulder Instability

Daniel McNeil, Matthew Provencher, Ivan H. Wong

Systematic Review

McNeil et al. performed a systematic review of the literature on several techniques of arthroscopic anatomic glenoid reconstruction (AAGR) for the treatment of anteroinferior shoulder instability. Twenty-seven studies published between 2008 and 2019 were identified for inclusion, and clinical results were available for 237 patients ranging in age from 16 to 67 years. Iliac crest autograft was used in 60% of patients, iliac crest allograft was used in 22%, and distal tibial allograft was used in 18%. Capsuloligamentous repair was performed with suture anchors in 95% of patients; the remaining 5% did not have soft-tissue repair. Patient satisfaction was high (90%), with low rates of instability (5%). Clinical examination demonstrated satisfactory range of motion, with good functional outcomes according to a variety of scoring instruments. Radiographic evaluation revealed high union rates (97%) but also high rates of resorption (range, 10% and 32%). The authors concluded that the current evidence demonstrates that AAGR is a safe procedure with good short-term to medium-term results that is worthy of further study.

How to Handle Minor and Major Bone Loss in the Shoulder

Giovanni Di Giacomo, Mattia Pugliese, Denny Tjiauw Tjoen Lie, Andrew Chia Chen Chou, Jiwu Chen, Nahum Rosenberg, Eiji Itoi

Current Concepts Review

Anterior shoulder instability is a challenging problem that has a major impact on quality of life, especially in young, active patients. A variety of surgical strategies can effectively address this issue. However, consensus is lacking on the parameters that favor one technique over another, especially when bone loss is present. This is because of the complex, dynamic interplay between humeral and glenoid bone loss (i.e., bipolar bone loss). There is an ongoing debate over the percentage of glenoid bone loss warranting bone block procedures: 13.5-15% has been used as an indicator for some procedures, although this value is not uniformly accepted. A multitude of other factors (i.e., age, sex, level of activity, etc.) come into play alongside bipolar bone loss, and the weight of each factor has yet to be fully elucidated. Refining the algorithm for determining the right procedure for the right patients will reduce the number of side effects stemming from a suboptimal treatment choice. Knowing how to manage a previous failure of surgical treatment is also key for the treating orthopaedic surgeon, who must be able to address the root cause of failure and react accordingly. The authors analyze key factors related treatment choice, summarize the current stance of the literature, and emphasize the need for further research.

Acromial Morphology Classifications Demonstrate Significant Correlation

Antonio Klasan, Domink Malcherczyk, Thomas Neri, Jascha Saul, Markus Dietmar Scoger, Thomas Jan Heyse, Bilal Forouk El-Zayat

Retrospective Diagnostic Study

Various classification systems for acromial morphology have been described in the literature. The purposes of this study were to determine whether there were correlations between different classifications in a large cohort and to establish whether there were differences according to age, side, and sex. The shoulder CT scans for 350 polytraumatized patients (232 males and 118 females ranging from 16 to 90 years of age) were retrospectively reviewed with regard to acromial slope, acromial type, lateral acromial angle (LAA), and acromial index. Analysis with use of the Pearson correlation coefficient demonstrated significant correlations between all classification systems. In addition, excellent correlations were noted for left-right comparisons of all measurements, sex showed no correlation to any of the measurements, and age was correlated with LAA and acromial type. These findings may aid the clinician in choosing which classification system to use when reporting on patients.

HAND AND WRIST

Novel Patient-Specific Visual Analogue Survey Following Collagenase Injection for Dupuytren Disease

Stephen Lyman, Jayme Kotsov, Chisa Hidaka, Quynh Tran, Naomi Roselaar, Norimasa Nakamura, Robert Hotchkiss

Prospective Cohort Study

Lyman et al. developed and validated an electronically administered patient-specific visual analogue survey (PVS) to evaluate changes in hand function after treatment with injectable collagenase clostridium histolyticum (CCH) in a study of 109 patients with Dupuytren contracture. The items in the PVS were authored and ranked in importance by the patients. Patients completed the PVS on the day of injection, on the day of manipulation, and at the time of the 30-day follow-up. For external validation, patients also completed standard patient-reported outcome measures (Overall Treatment Effects Scale and QuickDASH) and underwent physician assessment of contracture via goniometry and the table top test. Responses were highly individualized, with no single activity being chosen as important by more than 8% of patients; sports-related activities were mentioned most often (23%). The PVS was highly responsive to changes in patients' conditions following CCH injection and was more responsive than the QuickDASH (effect size, 1.49 compared 0.50). Additionally, the PVS had no floor or ceiling effects, whereas the QuickDASH ceiling approached 20% post-injection. The PVS had excellent internal consistency and correlated strongly with the QuickDASH post-injection. PVS scores were significantly higher for patients who reported improvement after injection than for those who reported no change. The test-retest reliability of the PVS was poor to fair, in part because patients were allowed to choose different activities at test and retest. However, among patients who rated the same activities at both intervals, test-retest reliability was good and was better than that of the QuickDASH. The authors concluded that the PVS is simple to administer and enables individualized assessment in a large number of patients. It is also readily adaptable for use in other diseases, particularly within musculoskeletal medicine.

LOWER EXTREMITY

HIP

Practical Office Ultrasound for the Hip Surgeon

Ehud Rath, Zachary T. Sharfman, Eyal Amar

Current Concepts Review

In this Current Concepts Review, Rath et al. describe the advantages of ultrasound for the hip surgeon. Ultrasound imaging allows for real-time dynamic visualization of muscles, tendons, fascial planes, and joints. This modality enhances the sensitivity of physical examination for the localization of pathology, improves clinical diagnostic accuracy, improves the accuracy of targeted injections without the need for fluoroscopy, is economically affordable and portable, and does not expose the patient or provider to radiation. A thorough understanding of the anatomy and biomechanics of the hip and a working knowledge of both intra-articular and extra-articular hip pathologies is essential to optimizing the utility of this modality. Ultrasound-guided injections allow for real-time visualization of both the needle and soft tissue or intra-articular target and are superior to unguided hip injections. Improved patient care can be achieved through the skilled use of ultrasound by a hip surgeon, radiologist, or ultrasound technician with appropriate training.

KNEE

Biplanar Ascending Opening-Wedge HTO Increases Tibial Tubercle-Trochlear Groove Distance and Decreases Patellar Height

Alexandre Barbieri Mestriner, Jakob Ackermann, Gergo Merkely, Takahiro Ogura, Juan Pablo Zicaro, Andreas H. Gomoll

Retrospective Case Study

The purpose of this study was to assess the effect of biplanar ascending opening-wedge high tibial osteotomy (OWHTO) on the alignment of the knee extensor mechanism and patellar height with use of preoperative and postoperative MRI.

The medical records of all patients who underwent ascending biplanar OWHTO between July 2008 and March 2017 were retrospectively assessed, and 26 patients were included. Five parameters of the patellofemoral joint—tibial tubercle-trochlear groove distance (TT-TG), patellofemoral (PF) axial engagement index, lateral patellar tilt, Blackburne-Peel index (BPI), and Caton-Deschamps index (CDI)—were measured by two blinded independent observers on preoperative and postoperative MRI scans. Interobserver reliability was assessed with the intraclass correlation coefficient (ICC), preoperative and postoperative measurements were compared with use of the paired t test, and the association of the amount of HTO opening and the PF joint parameters was assessed with Pearson correlation coefficient. Postoperatively, the authors reported significant increases in the TT-TG distance and small but significant decreases in patellar height that were correlated with the amount of axis correction.

Current Evidence on Patellar Tendon Grafts for ACLR for High-Risk Patients

Jérôme Murgier, Donald Hansom, Mark Clatworthy

Current Concepts Review

Hamstrings and patellar tendon (PT) are the most common autografts used to perform anterior cruciate ligament reconstruction (ACLR), and the debate regarding which type of graft is superior has been going on for decades. The purpose of this study was providing a current review based on recent scientific publications with high level of evidence. As noted by the authors, Joint Registries have provided conclusive information. The Scandinavian registry (>45,000 patients) showed lower a failure rate for bone-patellar tendon-bone (BPTB) graft than for hamstring tendon (HT) graft at 5 years (2.8% vs. 4.2%; $p < 0.001$). Similarly, the Norwegian registry (12,643 patients) showed higher revision rates for HT graft than for BPTB graft at both 2 years (2.8% vs. 0.7%) and 5 years (5.1% vs. 2.1%); the difference was even more significant among high-risk patients. This trend was confirmed in a study of young females, in which the failure rate was 6.4% in the PT group and 17.5% in the HT group at 3.7 years ($p=0.02$). The authors noted that ACL graft selection should be based on a discussion between the physician and the patient, taking into consideration age, activity level, and occupation. Within the high-risk patient group, however, scientific evidence supports the PT as the gold standard for ACLR.

Functional Improvement and Low Recurrence Rate After Combined Staged Synovectomy and External Radiotherapy for DPVNS of the Knee

Mohamed ElAttar, Hossam Fathi, Fahmy Samir Fahmy

Prospective Case Series

Treatment of diffuse pigmented villonodular synovitis (DPVNS) of the knee is problematic and controversial, with a high rate of morbidities and local recurrence. The purpose of this study was to perform a functional evaluation of patients with DPVNS who were managed with combined surgical and external radiosynovectomy. Between June 2011 and May 2015, 12 patients (4 males and 8 females) with DPVNS of the knee were managed with staged surgical synovectomy (arthroscopic anterior and open posterior) followed by low-dose external radiation. After a mean duration of follow-up of 46.7 ± 15 (range, 25 to 72 months), there were significant improvements in terms of range of motion and function. Three mild complications were encountered (superficial wound infection, repeated effusion, and transient neuropraxia). On the basis of their findings, the authors concluded that combined staged synovectomy and external radiotherapy provides improved function and quality of life with low rate of recurrence for patients with DPVNS of the knee.

Patients with Different Patellofemoral Disorders Display Distinct Ligament Stiffness Patterns Under Instrumented Stress-Testing

Ana Leal, Renato Andrade, Betina Hinckel, Marc Tompkins, Ricardo Bastos, Paulo Flores, Filipe Samuel, Joao Espregueira-Mendes, Elizabeth Arendt

Case Series

The purpose of this study was to investigate the patellar force-displacement profile (ligament stiffness) in patients with patellofemoral disorders. Fifty-two knees in 34 consecutive patients (mean age, 31.6 years; 53% male) were analyzed; of these, 24 knees had patellofemoral pain (PFP), 19 had potential patellofemoral instability (PPI), and 9 had objective patellofemoral instability (OPI). Physical examination, patient-reported outcome measures (Kujala and Lysholm scores), standard radiography, and MRI or CT were performed in all patients. Instrumented stress testing with use of the Porto Patella testing device concomitantly with imaging (MRI or CT) was performed to calculate ligament stiffness. The force-displacement curves in patients with PPI and OPI displayed a similar pattern, which was different from that in the PFP group. Patients in the PPI group showed higher ligament stiffness (a higher force was required to displace the patella) than those in the OPI group. Patients with OPI had a significantly shallower trochlear groove and increased lateral tilt.

More than half of the PPI and OPI populations presented with at least one classic risk factor (patella alta, trochlear dysplasia, increased quadriceps vector, lateral tilt). In the PPI group, 37% of patients had at least two risk factors, whereas in the OPI group, 33% of patients had three risk factors. None of the patients presented with all four anatomical risk factors. The author concluded that patients presenting with patellofemoral instability (PPI and OPI) display similar ligament stiffness patterns and that patients with PFP and PPI showed higher ligament stiffness as compared with patients with OPI.

Unexpectedly High Incidence of Venous Thromboembolism After Arthroscopic ACLR

Masaki Nagashima, Toshiro Otani, Kenichiro Takeshima, Hirokyuki Seki, Masanori Nakayama, Nobuto Origuchi, Ken Ishii

Prospective Observational Study

The objectives of this study were to investigate the incidence of deep venous thrombosis (DVT) and pulmonary embolism (PE) after anterior cruciate ligament reconstruction (ACLR) using ultrasonography (US) and contrast-enhanced CT (CECT) without pharmacological prophylaxis and to identify the risk factors for DVT. A prospective observational study of 55 consecutive Japanese patients undergoing ACLR (including 10 revision procedures) was performed. All operations were performed by one experienced surgeon with use of a tourniquet and a single-bundle hamstring autograft. US of the leg veins was performed on the sixth or seventh postoperative day. When a patient was diagnosed with DVT, CECT was performed to detect PE. Clinical factors were then compared between patients with and without DVT. After ACLR, DVT was detected in 9 patients (16.4%) and CECT showed that 4 of them had PE (representing an incidence of at least 7.3%). All patients were asymptomatic. The mean age was significantly higher for patients with DVT than for those without DVT (41.9 ± 15.7 years compared with 28.2 ± 14.2 years; $p = 0.012$). There were no significant differences between patients with and without DVT terms of other clinical factors, including sex, BMI, current smoking status, preoperative Lysholm score, time interval from injury to ACLR, type of procedure (primary or revision), preoperative knee pain, operative and tourniquet times, and meniscal repair. The authors concluded that the incidences of DVT and PE after ACLR were unexpectedly high and might suggest a need for thromboprophylaxis. As advanced age was identified as the risk factor for DVT in this study, patients with this risk factor should be considered for pharmacological prophylaxis after ACLR.

SUBMITTING TO *JISAKOS*

JISAKOS welcomes submissions from around the world.

All articles are subjected to rigorous double-blind peer review, and there are no submission or publication charges unless an author chooses to make their paper Open Access. Detailed information on manuscript submission and editorial policies can be found on the Author page of the website at **jisakos.bmj.com/pages/authors**.

JISAKOS adheres to the highest standards concerning its editorial policies on publication ethics and scientific misconduct.

The journal follows guidance produced by bodies that include the Committee on Publication Ethics (COPE), the World Association of Medical Editors (WAME), the Council of Science Editors and the International Committee of Medical Journal Editors (ICMJE). Detailed information on the aims and scope of the journal can be found on the About page of the website at **jisakos.bmj.com/pages/about**.

JISAKOS is currently indexed in both Google Scholar and Scopus and will apply of indexing in PubMed. As a relatively new journal, *JISAKOS* is not yet included in PubMed Central or PubMed. However, as soon as the required application criteria are met, the journal will apply for indexing in these databases. When accepted, article indexing will occur retroactively in both PubMed and PubMed Central.

Meniscal Repair Failure Risk Does Not Differ by Sex

Christopher Hamilton, David C. Flanigan, Kishan H. Patel, Nathaniel Lundy, Ryan Blackwell, Robert A. Magnussen

Systematic Review

Meniscal can be carried out with a variety of techniques. Regardless of technique and implant choice, it is critical to understand and consider patient-related factors, which can influence outcome. The purpose of this systematic review and meta-analysis was to determine if the sex of the patient has an effect on the risk of failure following meniscal repair. The authors identified 11 identified studies with a total of 886 patients (556 males and 330 females). Meniscal repair failure was reported in 192 patients (21.7%). The risk of failure was 21.1% for males and 21.5% for females. Meta-analyses demonstrated no significant difference in the risk of failure on the basis of sex in either the three studies in which repair success arthroscopically ($p = 0.66$) or the eight studies in which failure was defined on the basis of clinical assessment or the need for repeat surgery ($p = 0.92$). The authors noted that more data are needed to evaluate patient-reported outcomes of meniscal repair on the basis of sex.

ACL Reconstruction with Remnant Preservation

Benjamin B. Rothrauff, Eiji Kondo, Rainer Siebold, Joon Ho Wang, Kyoung Ho Yoon, Freddie H. Fu

Current Concepts Review

ACL tears are a common knee injury, and anatomic ACL reconstruction (ACLR) is now the standard of care to restore knee stability. Nevertheless, re-tear rates exceeding 5% are commonly reported, with an even higher percentage of patients being unable to achieve preinjury knee function. As the torn ACL remnant contains elements essential to ACL function (e.g., cells, blood vessels, and mechanoreceptors), it has been hypothesized that ACLR with remnant preservation may improve graft remodeling, in turn more quickly and completely restoring ACL structure and function. In this Current Concepts review, the summarized the present understanding of ACLR with remnant preservation, which includes selective bundle reconstruction of partial (one-bundle) ACL tears and single-bundle and double-bundle ACLR with minimal to partial debridement of the torn ACL stump. Reported benefits of remnant preservation included accelerated graft revascularization and remodeling, improved proprioception, decreased bone tunnel enlargement, individualized anatomical bone tunnel placement, improved objective knee stability, and early mechanical support (with selective bundle reconstruction) to healing tissues. However, clinical studies of ACLR with remnant preservation are heterogeneous in terms of the description of remnant characteristics and surgical technique. Currently, there is insufficient evidence to support the superiority of ACLR with remnant preservation over the standard technique.

The authors noted (1) that future studies should better describe the ACL tear pattern, remnant volume, remnant quality, and surgical technique, (2) that progress in understanding and applying remnant preservation may inform, and be reciprocally guided by, ongoing research on ACL repair, and (3) that the goal of research on ACLR with remnant preservation is not only to achieve anatomic structural restoration of the ACL but also to facilitate biological healing and regeneration to ensure a more robust and functional graft.

Medial-Side Knee Injuries: Simplifying the Controversies

David Figueroa, Rodrigo Guiloff, Alex Vaisman, Francisco Figueroa, Robert C. Schenck, Jr.

Current Concepts Review

Injuries to the medial side of the knee (MSK) are the most common knee ligament lesions. Historically, these injuries have been treated conservatively; however, a better understanding of the anatomy and biomechanics of the different structures of the MSK have resulted in diverse and controversial opinions about the ideal treatment of these lesions and variations in the literature with regard to the nomenclature used to describe the same surgical techniques. The diagnosis of MSK injuries must involve a critical thinking process to precisely identify which lesions imply an imminent risk of healing failure. This review article provides an evidence and clinical-based clarification of the controversies regarding injuries to the MSK and proposes an evidence-based algorithm for their treatment.

ANKLE

Endoscopic Release of Posterior Capsuloligamentous Structures for Painful Ankle Dorsiflexion

Benjamin Hickey, Miquel Dalmau-Pastor, Jón Karlsson, James Calder

Prospective Case Series

The purpose of this study was to evaluate the effect of arthroscopic release of the posterior capsuloligamentous structures on ankle dorsiflexion and function in patients with painful limitation of ankle dorsiflexion. Thirteen adult patients with a median age of 26 years (range, 19 to 44 years) were included. None of the patients had clinically relevant gastrocnemius, soleus, or Achilles contracture, and patients with anterior osseous impingement or ankle degeneration on CT scans were excluded. All patients underwent combined anterior and posterior ankle arthroscopies with resection of posterior capsuloligamentous structures and the posterior fibulotalocalcaneal ligament. At 2 years postoperatively, the ankle dorsiflexion range had increased by 15° (range, 0° to 25°) ($p < 0.0001$).

At a median of 3.7 years postoperatively, the Foot and Ankle Outcome Scores for pain, symptoms, activities of daily living, sports, and quality of life had all significantly improved as well. The authors concluded that hindfoot endoscopic release of the posterior ankle structures, including the posterior fibulotalocalcaneal ligament, is an effective technique for improving ankle dorsiflexion range in patients with painful limitation of ankle dorsiflexion.

Posterior Arthroscopic Treatment of Ankle Osteochondral Lesions

Jorge Pablo Batista, Hélder Miguel Duarte Pereira, C. Niek van Dijk, Jorge Javier Del Vecchio

Prospective Case Series

The aim of this study was to describe the clinical results of debridement and bone marrow stimulation by means of posterior ankle arthroscopy for the treatment of posterior osteochondral lesions of the talus. The authors hypothesized that posterior ankle arthroscopy is an effective and safe procedure to treat lesions <10 to 15 mm in size and <5 mm in depth located in zones 7, 8 and 9 of the Raikin and Elias grid. In this prospective analysis of the outcomes for 36 patients, the average American Orthopaedic Foot and Ankle Society clinical score improved from 42.3 preoperatively to 89.29 postoperatively. All patients were satisfied with the surgical outcome and stated that they would choose this procedure again. Three minor and transitory postoperative complications (5.55%) were observed: pain at the portals, ecchymosis, and hypoesthesia of the heel. The average VAS score improved from 7.75 preoperatively to 1.54 postoperatively, with an average improvement of 6.21 points. The majority (75%) of patients were able to resume their preinjury level of physical activity level. The authors concluded that the posterior arthroscopic approach with bone marrow stimulation is technically simple and is a safe and effective procedure for the treatment of posterior talar osteochondral lesions, with a low rate of complications, thereby reducing time to return to sports and/or work activity.

Endoscopic FHL Transfer to Augment Achilles Disorders

Jorge Pablo Batista, Jorge Javier Del Vecchio, Niek van Dijk, Helder Pereira

Technical Note

Many procedures have been described for the operative treatment of chronic Achilles tendon ruptures (CATR) and insertional calcific achilles tendinosis (ICAT). This technical note describes a novel technique for the treatment of such lesions. Fifteen patients who had undergone an endoscopic flexor hallucis longus (FHL) transfer to augment Achilles disorders between 2015 and 2016 were retrospectively identified. After an average duration of follow-up 11.27 months the overall success rate was 93.3%.

The mean American Orthopaedic Foot & Ankle Society (AOFAS) score was 62.27 points preoperatively and 91 points postoperatively. The average VAS score for pain was 6.93 preoperatively and 0.8 postoperatively. Only one patient (6.7%) required revision surgery. The advantages of FHL transfer are that it utilizes vascularized tendon with a strong viable muscle, has low morbidity, and is reproducible. On the basis of their findings, the authors concluded that this option may indicated for primary surgery in cases of CATR and non-insertional tendinopathy as well as for revision surgery in cases of ICAT.

SPORTS MEDICINE

Shoulder MRI in Asymptomatic Elite Volleyball Athletes Shows Extensive Pathology

Christopher Sy Lee, Nicole Hamilton Goldhaber, Shane M. Davis, Michelle L Dilley, Aaron Brock, Jill Wosmek, Emily H. Lee, Robert K. Lee, William B. Stetson

Observational Study

Elite overhead athletes, such as volleyball players, are predisposed to shoulder injuries due to repetitive overhead movement and overloading of the shoulder joint and surrounding muscles and ligaments. Returning to play at an elite level following shoulder surgery is often not possible. The authors hypothesized that MRI of the dominant shoulders of elite volleyball players would demonstrate extensive asymptomatic shoulder pathology that does not prevent the athlete from competing. To test this hypothesis, they evaluated the history, physical examination findings, and MRI findings for 26 asymptomatic elite volleyball players (14 mean and 12 women with mean age of 25.5 years) to determine the incidence of asymptomatic shoulder pathology. VAS pain scores, range of motion, strength, and UCLA and ASES outcome scores were measured and recorded. All MRIs showed abnormal pathology. Specifically, 23 athletes (88.5%) had rotator cuff tendinosis; 17 (65.4%) had partial rotator cuff tears involving the supraspinatus, infraspinatus, or subscapularis; 6 athletes (23.1%) had a labral tear; and 6 athletes (23.1%) had labral fraying. These findings support the notion that elite-level volleyball players can have asymptomatic shoulder abnormalities in their dominant arm that do not limit their ability to participate. The authors suggested that this knowledge will improve outcomes following the treatment of shoulder pain in overhead athletes and will prevent unnecessary surgical procedures.

Injury Prevention Programs with Plyometric and Strengthening Exercises Improve On-Field Performance

Daphne I. Ling, Nicholas A. Cepeda, Niv Marom, Bridget Jivanelli, Robert G. Marx

Systematic Review

Injury Prevention Programs (IPPs) have been shown to be highly efficacious for protecting young athletes from ACL and other lower-extremity injuries. In practice, however, the effectiveness of these programs has been limited because of poor adherence among coaches of organized sports teams. The authors hypothesized that a change in messaging from injury reduction to performance enhancement may be an effective strategy for improving adherence. To provide support for this hypothesis, the authors conducted a systematic review to address whether implementing IPPs can also provide benefits on sports performance as measured by on-field tests. Studies were selected for inclusion if they evaluated on-field performance testing before and after participation in the IPP or compared the IPP with another program or control. Studies were excluded if they evaluated programs without an explicit focus on injury prevention or reported on injury risk factors that were not related to athletic performance. The results of performance testing were summarized into the following categories: balance, sprinting, agility, jumping, physical fitness, and sport-specific skills. The analysis indicated that that IPPs can have beneficial effects on measures of sports performance and physical fitness. Factors that resulted in significant improvement included longer frequency and duration of IPP as well as the inclusion of plyometric and muscle-strengthening exercises. The authors concluded that enhanced performance on tests that can be conducted on the field with existing equipment may help to convince coaches and athletes to improve adherence to the IPP exercises.

ACL Injuries in Female Athletes

Nicholas Vaudreuil, Justin Roe, Lucy Salmon, Elvire Servien, Carola van Eck

Current Concepts Review

Female athletes represent a unique challenge for sports medicine providers. Care for skeletally mature female athletes requires an understanding of the distinct physiology, risk factors, and injury patterns that have been described in this population. ACL injuries are commonly observed in female athletes, especially those involved in high-risk sports such as soccer, basketball, lacrosse, and volleyball. Women have been shown to be at a higher risk for ACL injury compared with their male peers, even those competing in the same sport. Several factors must be considered when discussing the increased risk of ACL injuries in women. Anatomical factors and altered landing mechanics alignment contribute to increased forces in the ACL. A variety of other factors, including altered neuromuscular profiles, hormonal factors, and genetic factors, all may play a role in the increased predisposition toward ACL injury among female athletes. Prevention strategies such as proprioceptive training may be helpful, especially for at-risk activities such as landing and cutting drills. Optimal surgical management, including graft choice, is an area of debate. Postoperatively, return-to-sport protocols are not well standardized for female athletes. Women have a lower return-to-sport frequency, and psychological factors such as fear of reinjury are often cited as a predominant factor. More research is needed to elicit the reasons for physical and psychological differences between men and women in order to clarify optimal postoperative management.

BASIC SCIENCE

Biological Approaches to the Treatment of Osteoarthritis

Eric J. Cotter, Rachel M. Frank, Bert Mandelbaum

Current Concepts Review

The current treatment options for osteoarthritis include weight loss, activity modification, anti-inflammatory medications, steroid intra-articular injections, lubricating hyaluronic acid injections, and arthroplasty for end-stage cases. In recent decades, there has been interest in identifying biological treatment modalities to slow the progression of the disease and preserve native joints. The most commonly investigated biological treatments include platelet-rich plasma, bone marrow aspirate concentrate, and adipose-derived mesenchymal stem cells. The existing literature has demonstrated the anti-inflammatory properties of orthobiologics, but no treatment has clearly demonstrated significant joint preservation properties, including the ability to reverse the progression of osteoarthritis. In the majority of studies, these injection treatments have been shown to be safe. Research is ongoing to identify optimal indications, preparations, compositions, safety profiles, and clinical outcomes of biological therapies. This article reviews the current evidence on the use of biologics for the treatment of osteoarthritis as well as recent statements made by orthopaedic subspecialty groups on this important topic.

Doxycycline Improves Tendon and Cartilage Pathologies in Preclinical Studies

Robert S. Dean, David H. Kahat, Nathan R. Graden, Nicholas N. DePhillipo, Robert F. LaPrade

Current Concepts Review

Matrix metalloproteinases (MMPs), which are enzymes that are elevated during states of inflammation, have specifically been linked to cartilage, tendon, and bone pathologies. Concentrations of these enzymes fluctuate naturally with

various injury states, and these enzymes have been shown to be directly inhibited by doxycycline. Historically, doxycycline has been used exclusively for its antimicrobial properties, but recent studies have investigated the anti-inflammatory properties of doxycycline and its effects on musculoskeletal pathologies. The purpose of this review was to describe the current use of doxycycline for its MMP-inhibitory properties in the setting of musculoskeletal pathologies. During preclinical studies, improved healing properties were noted acutely at the site of tendon injuries and chronically at the site of cartilage injuries, with decreased rates of joint-space narrowing and improved cartilage quality. The only clinical trial that has examined doxycycline use to date indicated that doxycycline can decrease the rate of joint-space narrowing in patients with osteoarthritis. Furthermore, doxycycline is well tolerated, with minimal side effects in both animal and human studies. While it can be reasonably inferred that the positive effects of doxycycline are related to its ability to inhibit MMP activity, further clinical research is warranted to investigate the use of doxycycline in orthopaedic and musculoskeletal pathologies.

Biological Augmentation to Promote Meniscus Repair: From Basic Science to Clinical Application

Courtney R. Carlson Strother, Daniel B.F. Saris, Peter Verdonk, Norimasa Nakamura, Aaron J. Krych

State of the Art

Meniscal tears range from acute tears during physical activity to chronic degenerative tears. The role of the meniscus in knee stability, load distribution, knee proprioception, and arthritis prevention has been well established, and successful repair of meniscal tears provides better clinical outcomes and protection from increased degenerative changes. Advancements in surgical techniques have demonstrated that meniscal repair is possible for tears that were previously deemed unsalvageable. In addition, the use of biological augmentation has been associated with improved rates of meniscal healing. The use of biologics is an active area of investigation, and this article reviews current methods of biological augmentation to promote meniscal healing, including biological injections, concomitant procedures, and biological membranes.

ACADEMIC PUBLISHING

Increase in Publication Rates and Publication Bias Following Presentation at ISAKOS Biennial Congress

Brandon Alec Pagni, Jackson A. Middleton, Jeffrey S. Larson, Vehniah K. Tjong, Michael A. Terry, Ujash Sheth

The number of abstracts presented at the ISAKOS Biennial Congress has grown exponentially since the inaugural meeting in 1997. However, the rate of publication of abstracts presented at the Congress has not been studied since 1999, at which time the rate was found to be 39%. The primary objective of the current study was to provide an update on the rate of publication and to examine factors associated with publication. All abstracts presented at the 2013 ISAKOS Congress were obtained from the official meeting website. Searches for subsequent publications were conducted using the MEDLINE, EMBASE and Google Scholar by two independent reviewers. Data collected included presentation type (podium or poster), publication status (yes or no), study results (positive or negative), date of publication, journal name, and whether there were discrepancies between abstract and publication. Of the 746 abstracts presented at the 2013 ISAKOS Congress, 413 (55.4%) were published in peer-reviewed journals by the end of 2018, with a mean time to publication of 593 days. Podium presentations were significantly more likely to be published than poster presentations, with publication rates of 61.0% and 52.5%, respectively ($p < 0.03$). Abstracts with positive results were significantly more likely to be published than those with negative results with publication rates of 60.8% and 48.5%, respectively ($p < 0.001$). Discrepancies between the congress abstract and eventual publication were noted in 17% of studies. The authors concluded that the rate of publication of abstracts presented at the ISAKOS Congress has improved dramatically since this topic was last studied in 1999 and are comparable with those of abstracts presented other prominent orthopaedic and sport medicine conferences.

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ISAKOS CONGRESS PROGRAM HIGHLIGHTS

41 Symposia

36 Instructional Course Lectures

23 Surgical Demonstrations

15 Global Case-based Discussions

10 Debates

8 Award Presentations

5 Partner Society Symposia

2 Roundtable Panel Discussions

1 Awards and Traveling Fellowship Ceremony

1 *JISAKOS* Symposium Celebrating 25 Award Winners

4 PRE-COURSES IN MULTIPLE LANGUAGES

Select pre-courses offered both in English and Spanish, Portuguese, French, and Mandarin with a combined Live faculty discussion in English

KNEE PRESERVATION offered in Mandarin & English
SAVE THE MENISCUS offered in Portuguese & English

HIP PRESERVATION offered in French & English
TREATING THE INJURED FOOTBALL PLAYER offered in Spanish & English

1 SPORTS REHABILITATION CONCURRENT COURSE

offered half day Saturday, full day Sunday and Monday

MULTIPLE PODIUM ABSTRACT PRESENTATIONS & ePOSTERS

2021 Congress program and details are subject to change.

8 AWARD PODIUM PRESENTATIONS

- Achilles Orthopaedic Sports Medicine Research Award
- Albert Trillat Young Investigator's Award
- Gary G. Poehling Award
- Jan I. Gillquist Scientific Award
- John J. Joyce Award
- Paolo Aglietti Award
- Patellofemoral Research Excellence Award
- Richard B. Caspari Award

36 INSTRUCTIONAL COURSE LECTURES

ANKLE:

- Lateral Ankle Ligament Repair Techniques
- Osteochondral Lesions of the Talus

ELBOW:

- Advanced Elbow: Current Surgical Techniques for Elbow Instability and Tendon Ruptures
- Basic Wrist: What a Sports Surgeon Should Know About the Wrist

HIP:

- Conversion to THA: A Treatment Path or a Treatment Failure?
- Hip Labral Reconstruction: Who Needs It and What Are the Options?
- Hip Pain Beyond FAIs and Labral Pathology: The Extra-Articular Impingement

KNEE:

- Clinical Examination of the Knee: A Lost Art
- Graft Choice for ACL Reconstruction
- Graft Harvest Techniques and Graft Preparation for ACL Reconstruction
- How Can We Improve Range of Motion After Total Knee Arthroplasty (TKA)?
- How To Perform a Successful R evision TKR. A Step-Wise Case–Based Approach
- How to Repair the Meniscus in a Difficult Situation
- Managing the Posterolateral Corner
- Management of High-grade Medial-Sided Knee Injuries
- Management of Revision ACL
- Masterclass on MRI Reading of the Injured Knee
- Maximizing Outcomes in Primary TKA: Tips and Pearls
- Non-Surgical Management of Knee Osteoarthritis
- Optimizing our ACL Reconstruction: When to Add a HTO or an Anterolateral Augmentation?
- Patellar Dislocation in the Skeletally Immature Patient
- Posterior Cruciate Ligament: What's New?
- Patellofemoral Cartilage Defects: The ISAKOS Perspective
- Return to Sport Testing After ACL Reconstruction: Should We Be Doing It?
- Surgical Management of the Multi-ligament Knee Injury
- Tips and Tricks (and Results) of Osteotomies Around the Knee.
- The Unhappy TKR Patient: A Comprehensive Case-Based Approach to Assessment of Etiology
- UKA: Indication and Surgical Technique

SHOULDER:

- Bone Grafts of the Shoulder
- Current Status on Reverse Shoulder Prosthesis (RSP): When and How?
- Infections in Shoulder Surgery: Diagnosis and Management
- Shoulder Instability: A Case-Based ICL
- Shoulder Rotator Cuff Repair (RCR): Techniques to Get It Right
- Indications and Results of Reverse Shoulder Arthroplasty

SPORTS MEDICINE:

- Biologic Treatment Strategies for Troublesome Stress Fractures in Elite Athletes
- Practical Applications of Growth Factors, Cells, and Novel Therapies in Sports Medicine

DEBATES

- ACL Graft Choice: Artificial versus Allograft versus Big Three Autografts
- ACL Reconstruction versus ACL and Lateral Procedure
- Failed Cartilage Surgery: what to do next?
- Practical Approaches to Revision ACL
- Risk Factors in Shoulder Instability Surgery and Outcome Measures Ballroom West
- Shoulder the Failed Rotator Cuff: Revision Repair
- Surgical Versus Non-Surgical Management of Acute Grade 3 Inversion Ankle Sprains
- Technical Considerations in TKA: Old School versus New School
- The Role of Osteotomy in the Management of Patellofemoral Conditions
- UKA vs HTO for the young and active arthritic patient

GLOBAL CASE-BASED DISCUSSIONS

- Avoiding Tunnel Coalition in Ligament Surgery (ACL-PLC, PCL-MCL, HTO-ACL, ACL-ALL / LET, ACL-Meniscus root)
- Expanding the Use of Knee Osteochondral Allografts Around the World
- First Time Patellar Dislocations – Are We Doing the Best We Can?
- Graft Choice for the Young ACL
- Knee Dislocations
- Meet the Expert: Knee Arthroplasty
- Meet the Experts: Knee Ligaments
- Meet the Expert: Shoulder Instability
- Meet the Expert: Shoulder Massive Rotator Cuff
- Meniscus Root Repair – State of the Art
- Post Meniscectomy Pain Management Before the OA has Arrived
- Return to Play After Shoulder Surgery
- Revision TKA
- The Stiff Shoulder
- What Works Best for the Athlete: Meniscus Repair or Resection?

SYMPOSIA

- **ISAKOS 25th Anniversary: The Road to Create ISAKOS 25 Years Ago**
- ISAKOS Research Symposium
- ***JISAKOS*: How to get Published in The *Journal of ISAKOS*: Editor's Tips for Maximizing Your Journal Submissions**
- Meet the Experts: Gender & Diversity
- Meet the Experts: Working Through COVID-19
- Translational Research: From Bench to Bedside

ANKLE

- Controversies in Achilles Tendon Ruptures
- More than a Sprain: When to Fix the Deltoid in Syndesmotic Injury
- Pearls and Pitfalls in Management of 5th Metatarsal Fractures in Athletes

KNEE

- ACL Injuries in Professional Soccer Players
- ACL Registries – What have they Taught Us
- Advances in Meniscus Substitution and Meniscus Replacement from Around the Globe
- Alignment in TKA – Update 2021
- All About Posterolateral Corner Injuries
- Anterolateral Rotatory Laxity
- Case Based Approach to Knee Joint Preservation and Cartilage Restoration
- Healing After ACL Reconstruction Including Rehabilitation and Return to Sport
- How Should I Perform my TKR – Conventional, PSI, Navigation or Robotic?
- Indication and Techniques for Revision ACL Reconstruction
- Is Neutral Alignment Important for TKA Outcome and Survival
- ISAKOS & Patellofemoral Foundation Highlights of Current Research from 2018 – 2021
- New Horizons in TKA Kinematics: The Behavior of the Replaced Knee
- Optimizing Primary ACLR – What Else Needs to be Addressed?
- Osteotomy
- Osteotomy and Knee Arthroplasty
- Osteotomy for Complex Knee Problems
- Pain Management After Knee Arthroscopy – Fighting the Opioid Epidemic
- Patellofemoral Joint Replacement in TKR
- Pediatric Knee Surgery: Current Concepts and Controversies
- Planning for Osteotomy: Coronal, Sagittal and Axial Plane
- Preventive Strategies for Anterior Cruciate Ligament Lesions in Football
- Quad Tendon ACL: Where We Are Now?
- Treatment of Infected TKA
- What Is New in ACL Reconstruction?
- What is New in Female ACL?
- Which TKR is Best for My Patients? A Comprehensive Guide to Avoid Prosthesis Failure

HIP

- The MCL – All You Ever Wanted to Know but Were Afraid to Ask!
- Hip Instability
- What's New in Hip

SHOULDER

- Shoulder RCT: How to Prevent and Manage Failed Rotator Cuff Surgery: Case-Based

SPORTS MEDICINE

- Lifetime Treatment for Cartilage and Osteochondral Lesions in Sports

PARTNER SOCIETY SYMPOSIA

- AANA Partner Society Symposium
- AOSSM Partner Society Symposium
- APKASS Partner Society Symposium
- ESSKA Partner Society Symposium
- SLARD Partner Society Symposium

ROUNDTABLE PANEL DISCUSSIONS

- Biologics or Hardware (mini metal) for Cartilage Lesions: When Too Young, When Too Old, When Too Active, When Too Sedentary?
- Orthobiologics

LECTURES HIGHLIGHTS

- ACL Career Highlights:

Freddie H. Fu, MD

- ISAKOS History & Legends

2021 Congress program and details are subject to change.

CALL FOR ABSTRACTS

ISAKOS CONGRESS 2021

Cape Town
South Africa
Nov 27 – Dec 1

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1. Log-in using the Presenting Author's email and password for ISAKOS (If a record does not exist for the Presenting Author, you will be prompted to create a new record).
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4. Submit the plain abstract text into the provided text box. Please note, graphics and tables are not accepted.
5. Complete the Financial Disclosure Statement, American Food and Drug Administration (FDA) Statement, and Copyright License Agreement, on behalf of all authors.
6. Author Warranty: Authors must read and abide by the Abstract Submission Guidelines in order to be considered for presentation.

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REGISTRATION OPENS

March 1, 2021!

Case Corner: Young Patient with Femoral Head Limited Subchondral Collapse and Possible Impingement Symptoms

Iftach Hetsroni, MD, Associate Prof.
Meir General Hospital, Kfar Saba, and Sackler Faculty of Medicine Tel Aviv University, ISRAEL

Patient

The patient is a 15-year-old female patient with a bone age of 13 years because of long-term growth hormone (GH) treatment for short stature. Currently, the patient is of normal height and appears completely normal physically. She recently stopped the GH treatment. She also has celiac disease but is otherwise healthy. She was an artistic gymnast until recently. The patient reports that she has had left hip pain for >6 months. She has less pain while sitting and more pain during activities. She sometimes limps during activities. She reports no catching or clicking and has no fever.

Clinical findings

At the time of the first visit (>6 months after the first symptoms), the patient was limping. However, by the second visit (9 months after the first symptoms), the patient had essentially no limp and almost no pain during straight walking. The most pronounced finding was pain on FADIR (flexion, adduction, and internal rotation) testing. There was no pain with flexion-external rotation. Internal rotation was limited to 0° on the involved side, compared with 30° on the contralateral side. There was also pain with the log roll test.

Diagnosis

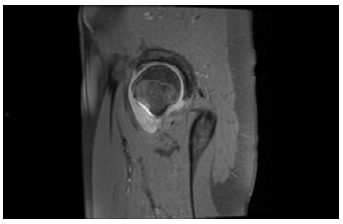
Limited subchondral collapse of the left femoral head with chondral surface flattening and reactive osteophytes at the head-neck junction. This may be consistent with Grade 3–4 osteonecrosis or subchondral fracture of other etiology.

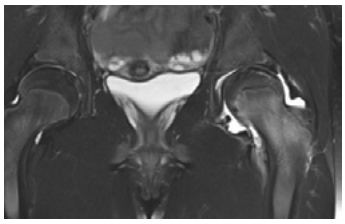
How would you address this case with the ultimate goal of joint preservation in a young active female?

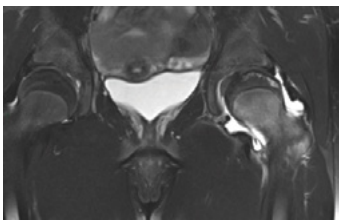
1. Is there any reproducible surgery to address the lesioned area in order to restore femoral head convexity and joint congruity?
2. Would you consider arthroscopic intervention for head-neck junction decompression because of the impingement symptoms (currently less pain during walking and more pain on FADIR testing)?
3. What is the likelihood that this treatment could lead to substantial long-term improvement?

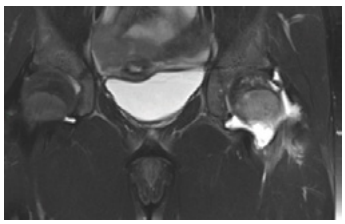
Radiographs

MRI Scans

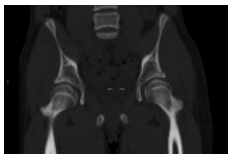


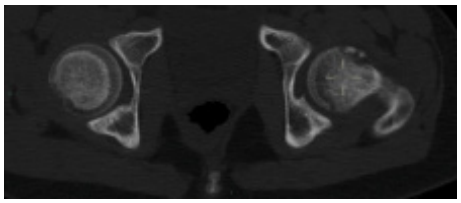


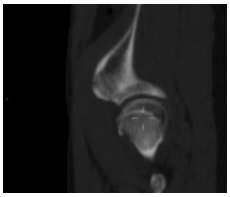


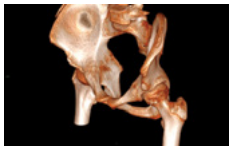


CT Scans









Case Corner Commentary

Young Patient with Femoral Head Limited Subchondral Collapse and Possible Impingement Symptoms

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We thank Dr. Hetsroni for the very unusual case. This case is an example of one of the greatest challenges that orthopaedic sports surgeons and regenerative medicine doctors face today and will probably face in the future, namely, joint-preservation surgery for the treatment of chondral and subchondral disease in young active adults. We have provided 3 different perspectives, and, as is evident from the responses, there is no uniform consensus on the treatment options; as such, further research and clinical information about such cases in the future is needed and valuable.

Aaron J. Krych, MD

This case illustrates a very challenging problem. In this very young (15-year-old) female patient who is approaching skeletal maturity, the femoral head has developed osteonecrosis with subchondral collapse, resulting in secondary impingement issues and degenerative changes.

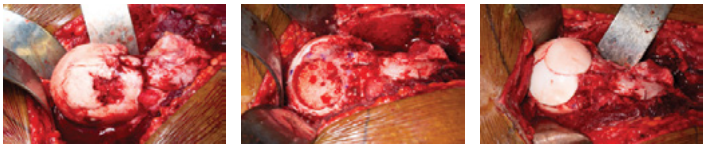
Current evidence indicates that small, asymptomatic lesions may be treated nonoperatively with close observation. So, if this patient is truly asymptomatic, such treatment may be an option. In contrast, core decompression is a viable option for a symptomatic patient without subchondral collapse.

Once subchondral collapse has occurred, as in this patient, then bone-grafting or hip arthroplasty may become more reproducible options.

In this patient, we would prefer to perform a biological joint-preservation procedure. At the Mayo Clinic, we have extensive experience with the use of fresh osteochondral allografts for the treatment of osteonecrosis of the knee, and the long-term results of such treatment for young patients with isolated lesions have been good to excellent. We are very fortunate to have access to fresh osteochondral grafts at our institution, so that would be our preferred option in this case.

For the procedure, we obtain a fresh osteochondral graft typically consisting of either a femoral head or, more commonly, a large lateral femoral condyle. Femoral heads are scarce, and the radius of curvature of the lateral femoral condyle seems to work well, so the latter is a common graft choice. The procedure is performed through an open surgical hip dislocation to preserve the remaining blood supply to the femoral head. Any concomitant femoral neck osteoplasty for the treatment of impingement can be performed at the same time. Such treatment would seem to be a good option for the patient presented here, who has impingement and symptoms.

We first remove the collapsed bone and dead cartilage from the defect. We then plan for multiple osteochondral dowels in a press-fit fashion. Figure 1 shows intraoperative photographs for a 15-year-old male patient with similar pathological findings to the patient described by Hetsroni.



01A–C

We ream to a depth of 6–8 mm and ensure good bleeding bone. If deeper bone is affected, then we usually remove the dead bone with a curet and insert local autograft bone from the trochanteric osteotomy. We prefer not to place a composite graft measuring >6–8 mm in thickness as doing so may lead to collapse of the graft over time. We then place the first dowel plug with use of a press-fit technique. In the sample case described here, the defect requires placement of a second allograft dowel in a "snowman" configuration. We temporarily pin the first plug, ream, and then place the second plug. In most cases, no addition fixation is required. We check range of motion to ensure that there is no residual impingement. We then fix the trochanteric osteotomy of the surgical hip dislocation. Postoperatively, the patient is kept non-weight-bearing for 6–8 weeks and then is allowed to progress to non-impact activities (while avoiding running and jumping) for the first 12 months after the procedure.

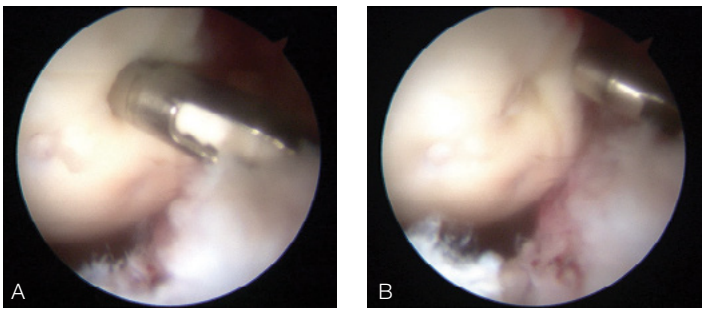
Young Patient with Femoral Head Limited Subchondral Collapse and Possible Impingement Symptoms

At 1 year, magnetic resonance imaging (MRI) is used to assess for adequate healing and creeping substitution of the graft before the patient returns to more vigorous activities. At the time of the latest follow-up, our patient (the 15-year-old male patient with intraoperative photographs) was pain-free and had returned to running and heavy squats. The results of our procedure need to be followed closely and compared with those of other treatments, but we believe that our approach has been a successful option for young patients with osteonecrosis of the femoral head and secondary subchondral collapse.

Hajime Utsunomiya, MD, PhD

This is a challenging case in a female gymnastic athlete. In my opinion, this is a typical case of subchondral insufficiency fracture of the femoral head (SIFFH). The T2-weighted MRI scan shows a high-signal band at the femoral head. The most important finding is that the band is parallel to the subchondral area along the femoral head. I believe that the classic findings of SIFFH are a diffuse femoral head bone-marrow edema pattern and an irregular/serpiginous subchondral band. Proton or T1-weighted MRI will be required to diagnose it firmly.

As for the treatment options, conservative treatment has to be the first choice. Although the left hip symptoms have improved, arthroscopic management must be considered for several reasons. First, associated labral injury could be the cause of SIFFH. We have reported that SIFFH is highly associated with labral tearing. Second, arthroscopic surgery is beneficial to directly diagnose the cartilage state in a patient with SIFFH. Third, SIFFH can be fixed by means of arthroscopic internal fixation with use of hydroxyapatite-poly-L-lactic acid (HA/PLLA) pins (Fig. 2). Please refer to our article regarding the arthroscopic classification and treatment of SIFFH (Uchida and Utsunomiya et al., KSSTA 2018). Fourth, the reactive osteophytes at the head-neck junction are severe enough to cause impingement and limit the range of internal rotation. Given these considerations, the best treatment option in this case would be (1) arthroscopic evaluation of SIFFH, (2) internal fixation of SIFFH with use of an HA/PLLA pin, if necessary, (3) labral repair, if necessary, (4) cam osteochondroplasty, and (5) capsular plication.



02A–B

We have to be careful because of the potential risk that the patient is still skeletally immature; her bone age is 13 years because of GH treatment. Also, the patient has an open physis at the femoral head-neck junction. We found that cam regrowth occurred in 4 of 27 skeletally immature patients who underwent arthroscopic hip surgery (Arashi et al., Acta Orthop 2019). This risk is non-negligible risk for this patient; however, the benefit of the above-mentioned arthroscopic treatment may outweigh the risk of cam regrowth. Careful postoperative management, including frequent radiographic follow-up, will be required.

Rodrigo Mardones, MD

This is a very interesting case. I have observed similar cases in my practice. Clinically, the patient had both pain and a limp at 6 months, but 3 months later she had no pain and no limp. However, FADIR testing was positive and revealed evident motion restriction.

Radiographs in this case demonstrate a focal (<25%) collapse with a plain sclerotic line and retroverted acetabulum. On the frog-leg view, there is a minimal notch as well as a small convexity of the head (mini-bump). MRI scans show subchondral collapse with some high-grade signal at the crescent line without surrounding bone edema. However, there is also some edema of the femoral neck (diffuse) and a chondrolabral lesion. CT scans confirm the collapsed area with the mini-bump. In addition, we believe the location of the subchondral collapse may be consistent with sub spine impingement or acetabular rim retroversion.

Overall, these findings appear to be more consistent with a resolving post-traumatic subchondral fracture in an area of pincer impingement plus a chondrolabral lesion. Perhaps further testing with a local anaesthetic intra-articular injection would prove or disprove bone edema (active osteonecrosis) as the cause of pain.

03

Conservative treatment can be used while waiting for the resolution of the acute inflammation and subchondral fracture resolution. As the patient currently has no pain, I would delay any surgical treatment until the pain is worse and / or the patient skeletally mature (in 1 or 2 years). I would approach this case with hip arthroscopy to repair the chondrolabral lesion and treat the pincer impingement, combined with a small anterior wall acetabular resection and a mini bumpectomy. If the subchondral head lesion is big enough, then I would consider bone decompression combined with retrograde cancellous bone-packing or treatment with retrograde osteochondral autograft transfer system (OATS). At our institution, we utilize expanded mesenchymal stem cells (MSCs) as presented at the 2017 ISHA conference.

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Current Concepts in Managing Ankle Syndesmosis Injuries

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Introduction

Injuries to the ankle syndesmosis have demonstrated an increased prevalence among athletes of all levels, with an estimated incidence of 0.05 injury per 1,000 hours of exposure.[1] Impact and collision sports such as soccer, skiing, football, ice hockey, wrestling, and rugby exhibit a higher prevalence of injury.[1] It is also widely recognized that ligamentous syndesmotic injuries result in substantially longer times missed from sport compared with other ankle ligament injuries, are much more likely to require surgical stabilization, and are associated with more long-term functional sequelae. These factors have contributed to an increased focus on the diagnosis and management of syndesmotic injuries in sports medicine and athletic training circles in recent years.

The goal of this article is to present state-of-the-art information related to the diagnosis and management of syndesmotic injuries in athletes. We will focus on three areas in which meaningful recent advances and even paradigm shifts have occurred: (1) classification of syndesmotic injuries, (2) current fixation constructs and devices, and (3) return-to-play protocols for athletes suffering from these injuries.

Diagnosis and Classification of Syndesmosis Injuries

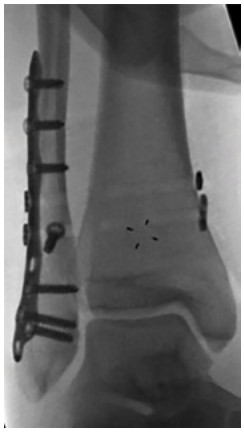
The first opportunity for the clinician to identify a syndesmotic injury is the physical examination. The most common clinical tests performed to assess syndesmotic injuries include the squeeze test, palpation over the anterior and posterior parts of the tibiofibular syndesmosis, lateral translation testing (e.g., the Cotton test), location of tenderness above the ankle joint line, and the fibular instability test.[2] Imaging studies, including weight-bearing radiographs and CT scans as well as MRI scans of the affected ankle, are commonly used to assist with decision-making. However, no current classification system includes all diagnostic modalities, and no system has been found to have suitable sensitivity and specificity to diagnose syndesmotic instability or to identify injuries that are less likely to improve with conservative management or more likely to risk long-term dysfunction.

One of the original classification schemes is the West Point Ankle Grading System. The West Point system separates syndesmotic injuries into three grades. Grade I is characterized by injury to the anterior inferior tibiofibular ligament (AITFL) with no ankle instability or diastasis.[2] Grade II is characterized by injury to the AITFL and partial tear of the interosseous ligament (IOL) with slight instability but no frank diastasis.[2] Grade-II injuries should be further stratified into stable (Grade IIa) and unstable (Grade IIb) to better guide treatment decisions made by clinicians. Grade-III injuries are characterized by complete disruption of all syndesmotic ligaments with frank instability and/or diastasis.[2] Compared with Grade-III injuries, which show mortise widening, Grade-I and II injuries do not display radiographic changes to the ankle mortise. Thus, it is challenging to assess injury severity for patients with Grade-II injuries with use of standard radiography. It is not until after the posterior inferior tibiofibular ligament (PITFL) and deltoid ligament are injured in association with the syndesmosis ligaments that changes are seen on two-dimensional (2D) radiography (Hunt et al., unpublished data).

The diagnostic advantage of MRI over 2D radiography is the reason why many support the Sikka classification system for syndesmotic injuries. This classification scheme separates ligament involvement into four different groups. Grade-I injuries involve an isolated injury to the AITFL, Grade-II injuries include involvement of the IOL and/or interosseous membrane (IOM), Grade-III injuries include involvement of the PITFL, and Grade-IV injuries include involvement of all ligaments and rupture of the deltoid ligament.[2] While not a perfect tool, MRI is essential for the diagnosis of moderate unstable syndesmotic injuries because it effectively displays ligamentous structures, has excellent interobserver agreement, and identifies secondary findings such as bone bruises, osteochondral lesions, and joint incongruity (Fig. 2).[2]

Current Concepts in Managing Ankle Syndesmosis Injuries

01 Intraoperative fluoroscopic image made during a stress test of the syndesmosis following fixation of a fibular fracture. Note the widening of the syndesmosis space, widening of the medial clear space, and lateral shift of the talus relative to the plafond.



02 Intraoperative fluoroscopic image made during a stress test of the syndesmosis following fixation of a fibular fracture with flexible fixation devices. Note the restoration of the ankle mortice and talus relative to the plafond.

The management of these injuries is separated into nonoperative and operative protocols on the basis of the stability or instability of the injury as indicated by imaging findings. The ESSKA-AFAS expert panel characterizes stable injuries as those involving the AITFL with or without an IOL injury and an intact deltoid ligament, and it characterizes unstable injuries as those associated with latent diastasis (rupture of the AITFL without rupture of the IOL and deltoid ligament) or frank diastasis (rupture of all syndesmotic and deltoid ligaments on standard radiographs).[2] The consensus panel recommends a short-leg cast or brace for stable injuries and recommends operative management for unstable injuries.[2]

Fixation Methods

History

Surgical fixation of syndesmotic injuries has evolved in recent years. Screw fixation of the syndesmosis was the standard of care for years as this method was really the only option available to the surgeon. Although screws successfully stabilize the widened tibiofibular articulation, the technique does not restore a normal biomechanical environment to the syndesmosis joint. In addition, screw breakage and additional surgery for hardware removal are recognized issues. As it became increasingly recognized that the syndesmosis was a joint that requires motion for normal function, more flexible device options and suture construct materials have been introduced, beginning around 2005 with the first suture-button implant (Tightrope; Arthrex).

Introduction and Popularity of Flexible Fixation Techniques

Over time, flexible fixation (e.g., suture-button) devices and hybrid constructs have been introduced and tested as an option to stabilize syndesmotic injuries. Small Level-IV studies showed good results with suture buttons for syndesmosis fixation, with no evidence of broken implants, earlier return to work, and a decreased need for hardware removal. In 2010, Bava et al. reported that flexible fixation was used in 10% of procedures. Subsequent Level-I and II studies comparing flexible fixation techniques and rigid screws demonstrated a number of common themes—namely, that suture buttons were associated with the same or better clinical outcomes compared with screws, that suture buttons were associated with a much lower rate of malreduction compared with screws, and that the adequacy of reduction was associated with better outcomes.

Shimozono et al., in a meta-analysis of randomized controlled trials evaluating the outcomes of screw versus suture-button fixation, found that the suture-button technique was associated with significantly improved functional outcomes, lower rates of broken implants, reduced need for removal of hardware, and fewer incidents of joint malreduction compared with the surgical screw technique.[4] All of these constructs successfully repair the syndesmotic gap but fail to restore native joint motion[3] or to address the rotational changes of the talus (Hunt et al., unpublished data). The clinical implications of these findings have yet to be determined; however, they suggest that a greater understanding of the syndesmosis during dynamic movements is necessary.

Restoring Biomechanics of the Ankle Syndesmosis

It is important to understand that most of the available clinical outcome studies on syndesmotic injuries involve patients with fractures that are associated with disruption of the syndesmosis, typically supination-external rotation injuries. It is also important to realize that an elite athlete with an unstable ligamentous injury of the syndesmosis will benefit from restoration of normal syndesmotic mechanics. We performed, in our laboratory, an in vivo assessment of normal three-dimensional (3D) mechanics under normal athletic conditions. In that study, we found that the shifts of the fibula at the level of the syndesmosis were largely posterior and external-rotation shifts rather than simple lateral widening. In fact, very little lateral widening can occur in an intact, uninjured syndesmosis. Instead, normal function during athletic activity is conveyed through rotation, anteroposterior, and superoinferior position shifts. No syndesmosis construct has been shown to restore normal mechanics following an unstable syndesmosis injury.

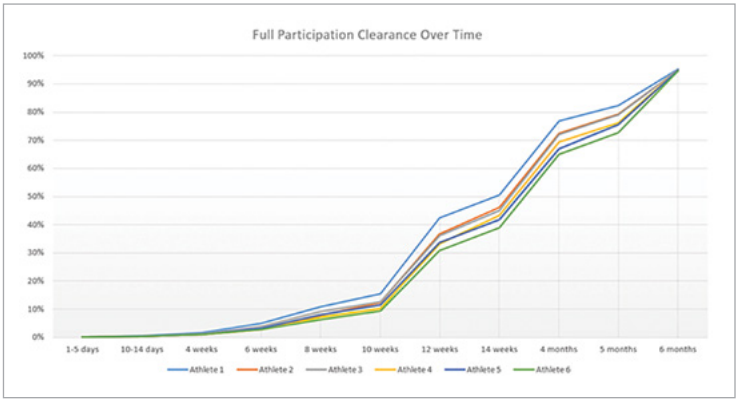
Return-to-Play Protocol and Survey Results

Return to Play

There is no consensus on a return-to-play protocol for athletes following syndesmotic injury. D'Hooghe et al., in a registry-based study involving 110 professional soccer players with Grade-IIb and III syndesmotic injuries, evaluated the time to return to sport-specific rehabilitation, the time to return to team training, and the time to the first official soccer match after injury.[5] The authors found that none of the athletes had participated in an official match at 1 month after surgery and that only 4% had done so within 2 months after surgery. The mean time to begin on-field/sport-specific rehabilitation was 37 ± 12 days, and the mean time of to the first match after syndesmotic stabilization was 103 ± 28 days.

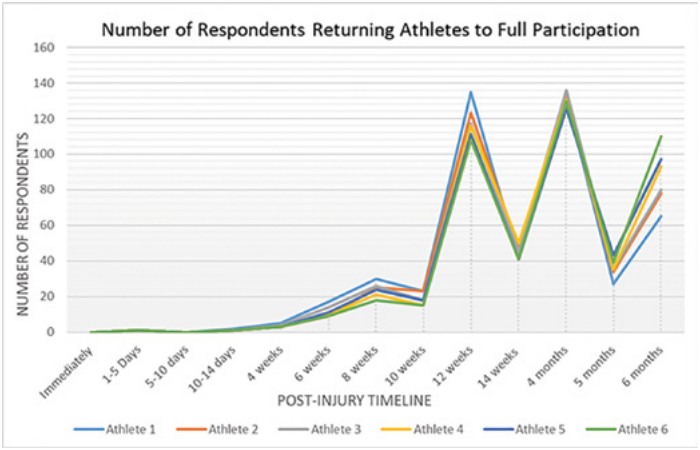
Global Perspective

The ISAKOS LAF committee recently surveyed >500 orthopaedic surgeons specializing in ankle injuries from across the globe, including members of ISAKOS and all major orthopaedic sports medicine societies. Survey participants answered questions focused on their indications for the treatment of syndesmotic injuries, the information that they used during their decision-making process, and their preferred technique (either suture-buttons or syndesmotic screws) for the operative repair of indicated syndesmotic injuries. Six hypothetical athlete scenarios were constructed to assess the preferred duration of rehabilitation and graduation to activity in each variation of syndesmotic injury. Flexible devices were the preferred fixation construct (48%), followed by screws (27%), hybrid fixation (19%), and other (6%). There was a higher preference for flexible devices among providers who were trained in sports medicine (58%) relative to those who were not (44%).



03 Graph illustrating the percentage of surveyed surgeons who would clear each athlete for full participation over time. Six hypothetical elite athlete scenarios were constructed with varying degrees of injury: moderate-impact injury with and without a complete deltoid tear (Athletes 1 and 2, respectively), high-impact injury with and without a complete deltoid tear (Athletes 3 and 4, respectively), and very-high-impact injury with and without a complete deltoid tear (Athletes 5 and 6, respectively). The moderate-impact athlete was described as a 180-pound tennis player (Athletes 1 and 2), the high-impact athlete was described as a 220-pound wide receiver (Athletes 3 and 4), and the very-high-impact athlete was described as a 300-pound defensive lineman (Athletes 5 and 6).

Sixty-two percent of respondents noted that their rehabilitation protocols would not change for each athlete scenario. Considerable variability was noted with regard to the anticipated timing before full return to sport, ranging from immediately following the injury to 6 months postoperatively (Fig. 3). On the basis of the results of our survey, we inferred that regardless of the severity of the injury to the syndesmosis, device choice and return-to-play protocol were not consistent internationally, and thus no consensus has been made among providers that treat syndesmotic injuries.



04 Graph illustrating the number of surveyed surgeons who would clear each athlete for full participation at each of the specified times. Six hypothetical elite athlete scenarios were constructed with varying degrees of injury: moderate-impact injury with and without a complete deltoid tear (Athletes 1 and 2, respectively), high-impact injury with and without a complete deltoid tear (Athletes 3 and 4, respectively), and very-high-impact injury with and without a complete deltoid tear (Athletes 5 and 6, respectively). The moderate-impact athlete was described as a 180-pound tennis player (Athletes 1 and 2), the high-impact athlete was described as a 220-pound wide receiver (Athletes 3 and 4), and the very-high-impact athlete was described as a 300-pound defensive lineman (Athletes 5 and 6).

Alabama Experience and the Media

Recently, the medical team with the University of Alabama football program (Tuscaloosa, Alabama, USA) began implementing an accelerated postoperative protocol for patients undergoing syndesmosis-stabilization surgery with the Tightrope technique (which involves drilling quadricortical tunnels through the fibula and tibia and then implanting the Tightrope device to reduce the syndesmotic gap and repairing the injured ligaments). According to media reports, athletes in that program who have undergone such treatment can return to sport-specific training within 12 days and are able to compete in games once they can perform 15 single-leg hops (https://www.si.com/college/2019/10/20/tua-tagovailoa-ankle-injury-alabama-lsu-outlook). Aggressive rehabilitation has been a staple in their injury protocol and has successfully allowed the medial staff to get impact players back on the field and performing at a high level at a quicker rate than ever before.

Current Concepts in Managing Ankle Syndesmosis Injuries

The reported success of these aggressive postoperative rehabilitation protocols has generated an international conversation on whether prolonged immobilization, protected weight-bearing, and delayed return to sport is really necessary in all cases following surgical stabilization. The experience at this NCAA institution also has brought media attention and more public awareness to flexible device techniques. The ISAKOS LAF survey suggests that there is substantial variability in return-to-sport protocols, although the mean values of survey responses and those in in D'Hooghe et al.'s study are strikingly similar.

Conclusion

Syndesmotic injuries are very common in field and court sports. Injury severity, nuanced diagnosis, and long-term functional risk have led to significant advances in diagnosis and management protocols. Indeed, our approach to these injuries has changed considerably, even in the last decade. While there is an ongoing need for additional science to support new surgical stabilization constructs and accelerated return-to-sport protocols, the current management ethos has evolved toward flexible-fixation-device constructs and accelerated return-to-sport protocols. Perhaps the most valuable tools to inform our understanding of the results of evolving treatment strategies are sports registries such as that described by D'Hooghe et al. Such registries, when inclusive of critical data elements classifying injury and specifying treatment, have immense real-world value in guiding treatment protocols for athletes. The ISAKOS LAF committee has envisioned an international collaboration of registries and institutional datasets to help us understand current treatment outcomes. Until data from such collaboration are broadly available, we rely on reports of outcomes from a rapidly evolving treatment landscape.

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Stem Cell-Based Treatment for Rotator Cuff Repair: Are We Talking About the Same Thing?

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Introduction

The development of new surgical techniques, implants, and specific postoperative aftercare protocols has led to substantial clinical improvement in patients managed with surgical rotator cuff repair. Nevertheless, this procedure is still associated with high failure rates. Older studies demonstrated retear rates ranging from 11% to 94%, and more recent studies have shown rates ranging from 11% to 57%. Given these findings, there is another factor that needs to be considered during our decision-making process: the biology. We have good data on different surgical constructs, and we are comfortable with the mechanical properties of our reconstructions. We also routinely account for the influence of additional mechanical factors, such as the critical shoulder angle or the acromial shape, on postoperative outcomes. But how do we account for the biology?

Tendon-healing typically comprises different elements: progenitor cells (often called stem cells), growth factors, a scaffold, and the vascular supply. Because of their reduced blood supply, tendons have a poor ability to regenerate and heal. In particular, the tendons of the rotator cuff have reduced intrinsic ability to regenerate all 4 physiological zones of the tendon-bone insertion. The cuff enthesis progresses from tendon to unmineralized fibrocartilage, to mineralized fibrocartilage, and, at the end, to bone. However, this zonal structure is not reproduced after surgical repair of a torn tendon. Instead, a biomechanically weaker fibrovascular scar tissue rich in type-III collagen is produced. It is believed that this weaker construct renders repairs prone to subsequent failure. Snyder even postulated that we do not see a retear but rather a tendon that never healed. Therefore, investigators have explored different ways influence the healing process by supporting reconstructions with cells or growth factors. One of the most popular topics of research is the use of so-called stem cells. The present article will provide an overview of the basics of stem-cell therapy, with a focus on how to define stem cells, how to measure and count these cells, and how to better understand and interpret scientific articles about cuff biology.

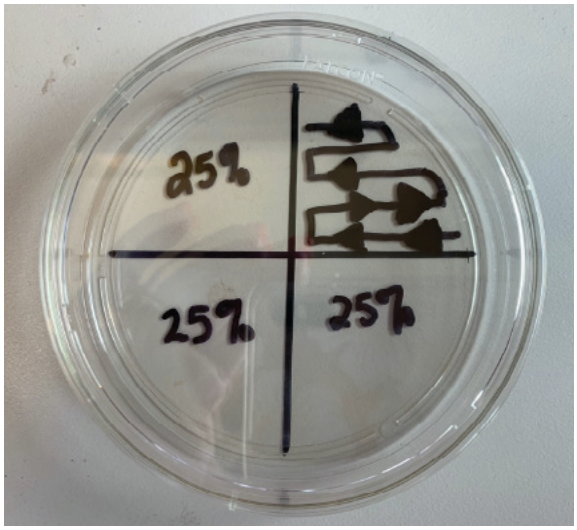
Mesenchymal Stem Cells

Stem cells are fundamental building blocks that are necessary for tissue reparation and homeostasis. They are pluripotent, are able to control immune processes, and secrete a milieu of anabolic mediators, thereby playing a key role in tissue regeneration. It was previously thought that all mesenchymal tissues contain the same types of stem cells, which are plastic-adherent and are identifiable by a specific surface marker profile; over the years, however, this theory has been proven to be incorrect[1]. It is no longer believed that there are ubiquitous stem cells in the mesenchyme with identical mesenchymal differentiation and regeneration potential across tissue boundaries. According to current definitions, mesenchymal stem cells are perivascular tissue-specific progenitor cells that are differently expressed in bone marrow, adipose tissue, umbilical cord blood, or synovial membrane and that they should only be called stem cells if extensive experiments have confirmed that they are capable of self-renewal and differentiation into all tissue cell types. Bone-marrow stem cells are the most frequently investigated type of cells and are the only type that can be called “stem cells” because it has already been proven that they fulfill the criteria. For other tissues such as fat, umbilical cord blood, or synovial membrane, one should correctly speak of stromal cells because this stem-cell proof is still pending.

Stem Cell-Based Treatment for Rotator Cuff Repair: Are We Talking About the Same Thing?

Preparations of highly concentrated primary cells from lipoaspirates, also referred to as stromal vascular fraction (SVF), are also obtained by means of purely physical methods. Collagenase-digested lipoaspirates are filtered, and the SVF is concentrated by centrifugation. These cell concentrates also include cells of the hematopoietic line such as granulocytes, monocytes, and lymphocytes in addition to endothelial cells, pericytes, and stromal cells. Although less rich in platelets and growth factors than bone-marrow aspirates, the SVF of lipoaspirates is also promising for regeneration and biological augmentation[1].

In order to compare the results from different studies involving bone marrow-derived "stem cells," a common terminology is essential[3]. The term mesenchymal stem cell (MSC) is often used interchangeably with the term connective-tissue progenitor cell (CTP). The number of nucleated cells found in concentrated bone marrow is counted and used as a predictor of the number of MSCs present. The nucleated cell population in bone marrow consists not only of MSCs but also macrophages, lymphocytes, and granulocytes. However, MSCs represent a very small fraction (0.001%–0.01%) of the total population of nucleated cells in bone marrow and are defined as cells that (1) are able to proliferate and form colony-forming units (CFUs) (consisting of ≥8 cells, with all cells being clones from one stem cell), (2) have the ability to adhere to plastic, and (3) express surface markers. These three characteristics set MSCs apart from the other nucleated cells found in bone marrow.

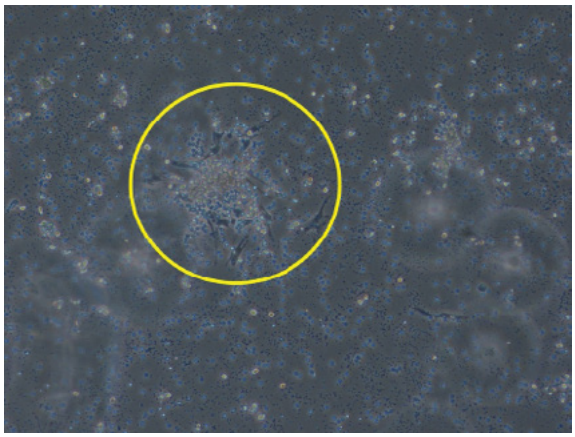


01 Standard method of counting CFUs after cultivation a sample on a culture dish. Only 25% of each culture dish area is counted microscopically, usually by one trained individual. (Courtesy of Mary Beth McCarthy, UConn Musculoskeletal Institute, Farmington, CT, USA)

It should be mentioned that the nucleated cell count is obtained via an automatic cell-counter machine, which counts every single cell. When counting CFUs, only 25% of each culture dish is counted microscopically, usually by one specially trained examiner. This number is then used to calculate the total number of CFUs in the culture plate and assumes an equal distribution of cells (Fig. 1)[5].

Although this technique is the gold standard for counting colonies, its results may vary and are dependent on the examiner's experience, the CFU distribution, and the time point of counting. Factors such as the patient's age may influence the number of CFUs, as laboratory studies have shown that younger patients have a more rapid appearance of CFUs compared with older patients.

In a culture dish in which CFUs have been established and multiple stem cells are communicating, it becomes impractical to know whether this group of cells comes from a single CFU or from multiple CFUs. Because of the increased age of the patient population with rotator cuff tears, a normal time point to count CFUs in clinical application would be 7-10 days after harvesting. In addition, the CTP prevalence (CFUs or CTPs / million nucleated cells) is an important marker for clinicians as it is a reference for the potential number of stem cells for biological augmentation.



02 Photograph showing CFUs in a specimen from a young patient after 48 hours of cultivation in a culture dish. The photograph was taken at 10x magnification, at which determination of 2 single CFUs is almost impossible. (Note that, because of formatting, there might be some scale differences in the image.) (Courtesy of Mary Beth McCarthy, UConn Musculoskeletal Institute, Farmington, CT, USA.)

Two different strategies for MSC application are currently used. The first technique is a simple local injection of a cell suspension that has been previously isolated or even purified ex vivo prior to reinjection. The aim of this strategy is for these cells to replace damaged cells within a tissue in order to reconstitute integrity and function[4].

The second technique, tissue-engineering, is more complex. With this method, cells are embedded inside a three-dimensional scaffold other matrix carrier to form a tissue-like construct that is fixed on top of, or inside a defect. Originally, the iliac crest was the primary choice of location for bone-marrow aspiration for MSCs. More recently, SVF cells, usually obtained from the biological waste generated during liposuction or lipectomy, have been identified as an option.

It should be noted that up to 500 times more cells can be isolated from fat tissue as compared with an equivalent amount of bone marrow[2]. However, many questions remain surrounding whether or not the concentration difference is real with respect to CTPs and whether or not SVF cells function in the same way. There are also several issues associated with obtaining adipose tissue, which must be digested in order to gain the theorized cell numbers that have been mentioned in previous studies. Nevertheless, local access to MSCs without the need for additional donor-site morbidity is advantageous.

In summary, is important to know the background when reading and interpreting research article about “stem cells,” “concentration of cells,” and the “number of cells.” Hopefully, this article will help to provide a better understanding of biological augmentation and tissue engineering in the field of orthopaedic surgery.

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Richard "Dick" Tooth, MD 1929 - 2020

Dr. Richard Murray Tooth was born at home in a small country town, Bombala in NSW, at the beginning of the great depression on September 21, 1929. Dick was a national icon of the Orthopaedics and Rugby Union. From his early days he demonstrated great athleticism and humility. His legacy is tremendous; Captain of the Wallabies, single figure golfer, A-grade tennis player, represented NSW in surf life-saving and squash. He was a Sydney–Hobart sailor as well as an accomplished pilot, flying to country centers providing outlying orthopaedic care. Dick would visit America regularly and visit the big three; Don Slocum, Don O’Donoghue and Jack Hughston to learn of the latest trends. It was through this connection that I was able to spend a year with Dr. Hughston. He was a major link in establishing international knee communication through the “International Knee Society”, becoming a founding member and its President for the Sydney meeting. He was a superb surgeon and teacher. He did the first knee reconstruction in NSW.

Being a pioneer in sports surgery, he saved a multitude of Australian sporting careers.

Dick, as well as being a great leader and mentor, was a great family man and leaves his beautiful wife of sixty six years, Marianne, and four children Robyn, Chris, Lianne and Kate.

-Mervyn J. Cross OAM, MBBS, MD, FRACS AUSTRALIA

Posterolateral Corner Surgery: Tips & Tricks from Asian Surgeons

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Introduction

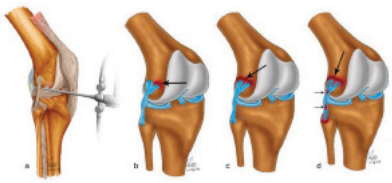
The posterolateral corner (PLC) of the knee was once an area that was poorly understood and much feared by surgeons. However, this area has been increasingly studied, and we now have a better understanding of PLC injuries. The three main structures of the PLC are the fibular collateral ligament (FCL), the popliteus tendon (PT), and the popliteofibular ligament (PFL). The FCL is the primary restraint to varus at lower flexion angles, the PT is the principal external rotation stabilizer at higher flexion angles, and the PFL stabilizes the knee in internal rotation.

Proper assessment and diagnosis of PLC injuries are essential for appropriate treatment. PLC repair and reconstruction are performed to restore knee stability. PLC reconstruction techniques can be broadly classified into non-anatomic and anatomic on the basis of the ligaments reconstructed and the position of the reconstruction tunnels. Anatomical reconstructions surgically reproduce the main 3 stabilizers to the PLC (the FCL, PT, and PFL) and their anatomical footprints. Non-anatomic reconstructions either do not reproduce all 3 structures or do so by means of non-anatomic attachments.

The anatomical PLC reconstruction technique proposed by LaPrade in 2004 has been adopted by surgeons worldwide, with modifications in fixation and graft choice. We present a collection of tips for assessing and treating PLC injuries as reported by Asian surgeons over the last 10 years[1].

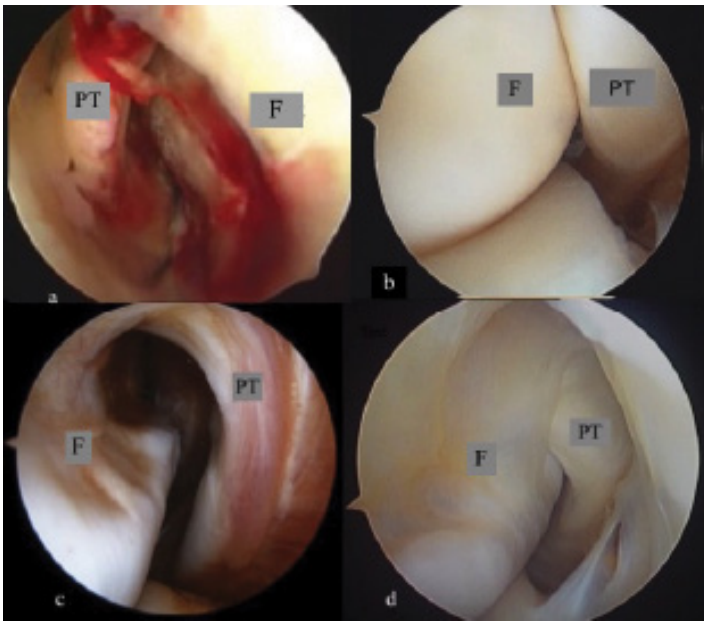
Lateral Gutter Drive-Through Sign and Femoral Popliteus Peel-Off Lesion

Feng and colleagues described the lateral gutter drive-through sign, defined as the arthroscopic finding of a lateral compartment joint opening of >1 cm, which is consistent with laxity of the FCL. In patients with a positive sign, the arthroscope passes into the posterolateral compartment through the interval and lateral femoral condyle at 30° of knee flexion, which indicates posterolateral rotatory instability of the knee (Fig. 1).



01A The lateral gutter drive-through test. The arthroscope is inserted through the interval between the popliteus tendon and the lateral condyle into the posterolateral compartment of the knee.
01B Type-I femoral peel-off lesion (isolated PT tear from the femoral insertion site).
01C Type-II femoral peel-off lesion (combined PT and FCL tears).
01D Type-III femoral peel-off lesion (complex tear with both the PT and FCL torn from the femoral insertion site with complex mid-substance injuries).

The same group described femoral popliteus peel-off lesions in a study of patients with acute PLC injuries (Fig. 2)[2]. They reported that 82% of patients with peel-off lesions showed conclusive evidence of femoral insertion separation and discontinuity. Physical examination revealed external rotation of >10° in 84% of patients and positive varus instability in 73%. Intraoperatively, arthroscopic findings of acute avulsion and a positive lateral gutter drive-through sign were found in 94% of patients.



02A Right knee. Arthroscopic view from the lateral portal shows the interval between the popliteus tendon (PT) and the lateral femoral condyle (F), the bare femoral insertion area with ecchymosis, and the torn end of the PT sitting up against the capsule, indicating a positive lateral gutter drive-through sign.

02B Left knee. The arthroscope cannot enter the interval between the popliteus tendon (PT) and the lateral femoral condyle (F), indicating a negative test.

02C TLeft knee. Arthroscopic view of the knee in a patient with a combined PCL and PLC injury, showing a positive lateral gutter drive-through sign. The arthroscope can enter the interval between the popliteus tendon (PT) and the lateral femoral condyle (F).

02D Left knee. Second-look arthroscopy, performed after combined PCL-PLC reconstruction, showing a negative lateral gutter drive-through sign.

That group also emphasized the importance of ensuring that the lateral gutter drive-through sign is negative after combined posterior cruciate ligament (PCL) and PLC surgery. In their cohort of patients who underwent combined PCL and PLC repair/reconstruction, patients who had second-look arthroscopy with a residual positive lateral gutter drive-through sign had inferior results.

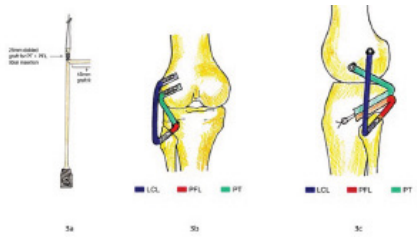
Peroneus Longus Autograft for Anatomical PLC Reconstruction

Tapasvi et al. proposed the use of peroneus longus tendon autograft as a Y graft for anatomical PLC reconstruction[3]. This technique provides an adequately sized autograft to reconstruct the PT, FCL, and PFL.

The peroneus longus autograft is used because of its length (usually 25–28 cm), its diameter (usually 6 mm), and its ease of harvest with low morbidity. A Y-shaped two-tailed graft is made by suturing the doubled tendon over itself for a length of 25 mm (for the popliteus) so that the free short end of the graft is at least 45 mm in length.

The lateral side of the knee is exposed, and anatomical landmarks are identified as described by LaPrade. The femoral sockets for the popliteus and FCL are drilled first, followed by the oblique fibular tunnel. The tibial tunnel for the popliteus is drilled for a length of 25 mm with a retro drill cutter. Graft passage is exactly reversed from the technique described by LaPrade.

The doubled 25-mm graft is initially passed in a blind tibial popliteus socket (Fig. 3). Tensioning is achieved by means of an adjustable loop with cortical tibial button fixation. Subsequently, the 2 free ends are used to reconstruct the 2 limbs of the PLC. The short free end of the graft is routed proximally to the popliteus femoral tunnel under the iliotibial band (ITB) and is fixed with a bioabsorbable screw with the knee in 90° of flexion and neutral rotation with a lateral closing force (Fig. 3).



03A Preparation of a peroneus longs autograft: the shorter free limb (45 mm) is used for reconstructing the popliteus, whereas the combined doubled loop is passed in the tibial tunnel from posterior to anterior.

03B and C Posteroanterior and lateral views. The doubled loop is passed in the tibial tunnel first and then is routed as 2 separate limbs, with the short limb passing to the popliteus tunnel (green) and the long limb passing to the fibula as the popliteofibular ligament (red) and then from the fibular tunnel to the lateral collateral ligament (i.e., FCL) insertion (blue).

Figs. 3-A through 3-C Schematic drawings depicting a left knee anatomical PLC reconstruction.

Last, the long free end is passed through the oblique fibular tunnel, from posterior to anterior. A bioabsorbable screw is passed in the fibular tunnel from anterior to posterior with the knee in 90° of flexion and neutral rotation and with a lateral closing force. Thereafter, it is passed from the anterior opening of the fibular tunnel to the femoral FCL tunnel, over the popliteus graft. It is then tensioned and fixed with a bioabsorbable screw with the knee in 30° of flexion and neutral rotation with a lateral closing force.

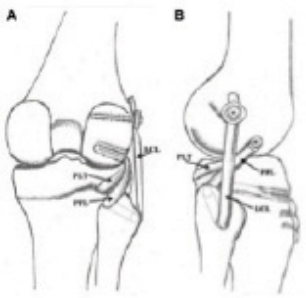
The technique allows for the use of a single autograft and is useful when allograft availability is limited. The clinical stability that is achieved is comparable to that achieved with double-graft technique, although this has not been validated in a biomechanical study.

Posterolateral Corner Surgery: Tips & Tricks from Asian Surgeons

Femorofibular-Based PFL Anatomical PLC Reconstruction

Many knee experts have modified the anatomical reconstruction to improve and further replicate anatomy. There are still limitations on how well surgeons are able to recreate the native anatomical structures of the PLC. First, the PT normally provides both dynamic and static stability to the knee. In PLC reconstruction procedures, the popliteus is converted to a static stabilizer. The implications of this conversion are still to be investigated. Second, the native PFL that originates from the musculotendinous junction of the PT is hard to mimic. As a result, there is no clear consensus on the procedure to reconstruct the site of the PFL origin on the PT.

Yoon et al. described a femorofibular-based PFL reconstruction that was different from the more commonly performed tibiofibular-based PFL reconstruction[3]. The authors emphasized that it was important (1) to reconstruct all 3 structures of the PLC (i.e., the FCL, PT, and PFL), (2) to anatomically reconstruct the femoral insertion of the FCL and PT, and (3) to anatomically reconstruct the fibular insertion of the PFL and FCL (Fig. 4).



04 Schematic drawings of a right knee showing posteroanterior (Fig. 4-A) and lateral (Fig. 4-B) views of graft fixation for anatomical PLC reconstruction with a femofibular-based PFL reconstruction. LCL = lateral collateral ligament (i.e., FCL), PFL = popliteofibular ligament, PLT = popliteal tendon.

Those authors advocated a femorofibular-based PFL reconstruction, as opposed to a tibiofibular-based PFL reconstruction, because the PFL is known to represent a static portion of the PT that extends from the posterior aspect of the fibular head to the origin of the PT. Therefore, to recreate the role of the static portion of the PT, that group believed that a femorofibular-based PFL reconstruction represents a more anatomical reconstruction in comparison with the tibiofibular-based PFL reconstruction. In a previous study, that group reported that there were no significant differences in clinical outcomes between femorofibular and tibiofibular-based PFL reconstruction groups.

Arthroscopic Posterolateral Capsular Stabilization

Isolated PLC injury is an uncommon knee pathology that could be a source of unexplained knee pain and dysfunction due to posterolateral rotational instability (PLRI). Ohnishi et al. devised an entirely arthroscopic approach for the treatment of isolated PLRI by stabilizing the posterolateral joint capsule along with the lateral meniscus on the rim of the lateral tibial plateau[5].

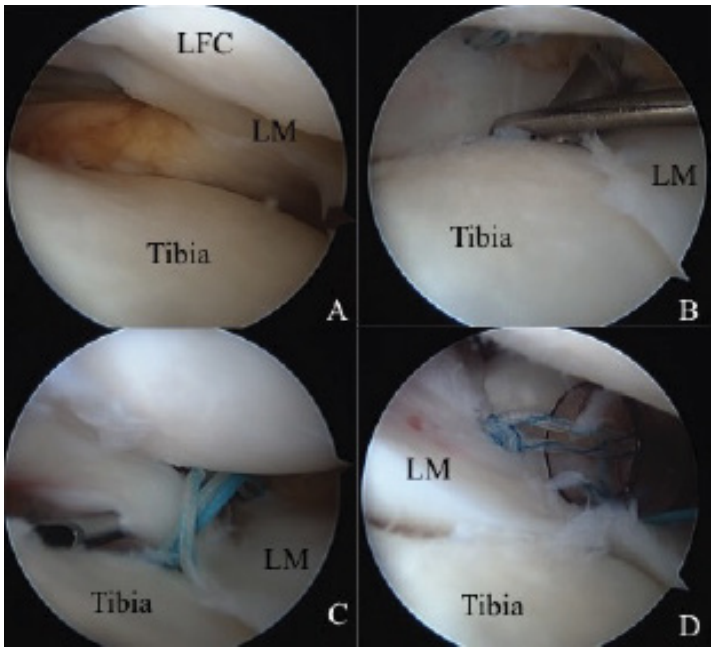
The patient is placed in the supine position under spinal or general anesthesia, and a standard arthroscopic examination is performed through an anteromedial portal. The drive-through sign is used to evaluate the PLC injury by measuring the displacement of the lateral meniscus with use of a probe (Fig. 5-A). A mid-lateral portal is created posterior to the FCL and 1 cm anterior to the popliteal hiatus. Then, with the scope in the anteromedial portal being used to view the site, a shaver is introduced through the mid-lateral or anterolateral portal. The rim of the lateral gutter of the tibia is abraded to remove cartilage and is prepared for anchor placement.

Two suture anchors (Y-knot anchor; ConMed) are placed on the rim of the lateral gutter after partial removal of the cartilage surface of the lateral aspect of the tibia (Fig. 5-B).

A QuickPass Suture Lasso (Arthrex) is inserted through the mid-lateral portal, and the tip penetrates the posterolateral joint capsule from superior to inferior (Fig. 5-C). The wire loop is advanced sufficiently into the knee joint. A suture grasper is inserted through the anterolateral portal, and a wire loop and 1 strand of braided suture are retrieved together. The retrieved braided suture is passed into the wire loop outside the portal, and the other limb of the wire loop is pulled to pass the braided suture from inferior to superior.

The same procedure is repeated for other strands of braided suture. The lateral meniscus and posterolateral capsule complex are fixed with mattress sutures with use of the suture relay technique (Fig. 5-D), which is less invasive and enables restoration of the stability of PLC.

Knee range-of-motion exercise without restriction is initiated immediately after surgery. Non-weight-bearing exercise with crutches is continued for 2 weeks. After 4 weeks, full-weight-bearing exercise is permitted as tolerated. Open kinetic chain exercise is started after 5 weeks, and closed kinetic chain exercise is started at 10 weeks. Deep squatting and jogging are allowed at 3 months, and return to sports is allowed after 4 months if muscle strength is well recovered and sports-specific ability is well acquired.



05A Drive-through sign.
05B Placement of anchor at the lateral gutter of the tibia.
05C Suture is passed through lateral meniscus (LM) and the posterolateral capsule complex. Fig. 5-D Knot tying of sutures.
Figs. 5-A through 5-D Arthroscopic views of the left knee through the anteromedial portal. LFC = lateral femoral condyle.

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In memory of late Co-Author

Feng Hua, MD CHINA

We received sad news of the sudden death of our co-author and dear friend, Professor Feng Hua, a week after this submission, on May 20, 2020.

Professor Feng Hua was a luminary in knee surgery who performed seminal research in meniscal ramp lesions, root tears, posterolateral corner injuries, knee rotatory instability, and more. He mentored hundreds of surgeons from China and other parts of Asia. With his exceptional thinking and dedication to knee surgery, Professor Feng Hua influenced a generation of knee surgeons around the world. He was an inspiration for Asian knee surgery on a global stage.

Most importantly, Professor Feng Hua was a gentleman and a wonderful human being who touched many with his generosity. He will be deeply missed by his friends in China and around the world. Our most sincere condolences to his family and colleagues from his hospital.

Calipered Kinematic Alignment for Total Knee Arthroplasty

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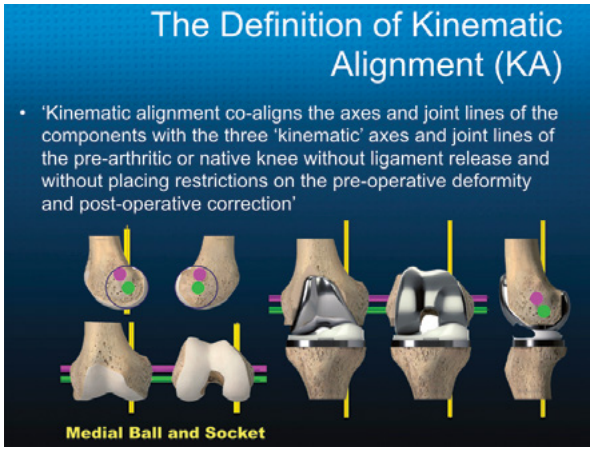
Calipered kinematic alignment is a new surgical approach that has received growing interest as an alternative to mechanically aligned total knee arthroplasty (TKA). This article summarizes the history of this approach, the literature on the topic, and my experience with the performance of >5,000 consecutive primary TKAs with use of calipered kinematic alignment since 2006. The philosophy behind calipered kinematic alignment is to set the joint lines of the femoral and tibial components coincident to the pre-arthritic or native joint lines without releasing healthy ligaments, without restricting the inclusion of patients on the basis of preoperative deformity, and without setting limits on the degree of postoperative correction (Figure 1).



01 Projections of a right femur (left) show the orthogonal relationships between the three kinematic axes of the native knee and the distal and posterior femoral joint lines, and kinematic alignment of the femoral and tibial components (right) coincident to the native joint lines. The flexion axis of the tibia is the green line, the flexion axis of the patella is the magenta line, and the longitudinal rotational axis of the tibia is the yellow line. All three axes are closely parallel or perpendicular to the joint lines. Compensating for wear and kerf and resecting bone from the distal parts of the femur and femoral condyles equal in thickness to the condyles of the femoral component kinematically co-aligns the axes of the components with those of the native knee.

Origin of the Three Kinematic Axes of the Knee

The concept of kinematic alignment originated in a laboratory study in 1993, in which Hollister et al. identified two kinematic axes: (1) a transverse axis in the femur, connecting the centers of the femoral condyles, about which the tibia flexes and extends, and (2) a vertical axis through the tibia, about which the femur rotates internally and externally. In 2003, Coughlin et al. identified a third kinematic axis of the native knee, also transverse in the femur, about which the patella flexes and extends. In 2004, Freeman and Pinskerova showed that the vertical axis passed through the center of the medial femoral condyle and medial tibial compartment. The medial centering of the vertical axis provides the biomechanical foundation for the medial stabilized implant design. These three axes are either parallel or perpendicular to the distal femoral and posterior femoral joint lines and the plane of the tibial joint line.

In 2005, Eckhoff et al. first questioned the foundation of mechanical alignment by showing that (1) the mechanical axis of the limb is not straight, (2) the kinematic axes are not related to the mechanical axes of the femur and tibia, and (3) the transepicondylar line is not the flexion-extension axis of the knee. In 2019, Hirschmann et al. wrote that the concept of neutrally aligning every TKA is dogma and is no longer logical according to several landmark studies. Accordingly, when technological offerings such as robotics, navigation, and patient-specific instrumentation target the mechanical axis instead of the three kinematic axes, the result is a "more accurate" malalignment of the knee joint leading to altered kinematics and increased wear and, ultimately, to premature failure of the arthroplasty.

In 2014, Nam et al., in a multicenter national study of patients managed with TKA, found that calipered kinematic alignment of the femoral and tibial components that retained the interrelationships between the three kinematic axes and joint lines of the native knee restored a more normal-feeling knee than mechanical alignment. Between 2012 and 2019, six of eight randomized or case-controlled trials comparing kinematic alignment with mechanical alignment demonstrated that kinematic alignment was associated with better motion, better alignment, better clinical outcomes, and comparable tibial component migration (Figure 2). The other two randomized trials showed similar results in association with kinematic and mechanical alignment; however, both of those studies included only patients with small deformities and set limits on the degree of postoperative correction, which adulterated the testing of kinematic alignment.

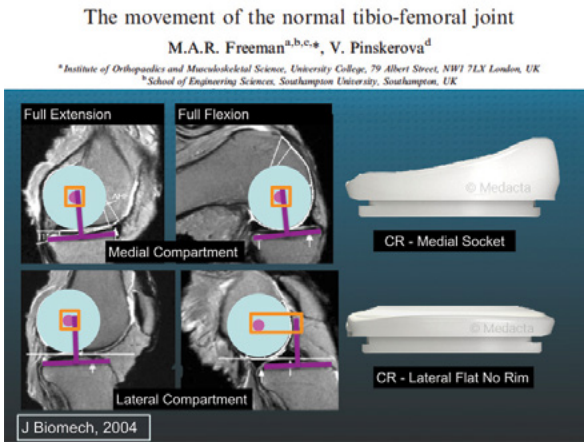
Summary of 8 Randomized or Case Control Trials Comparing Kinematic and Mechanical Alignment

Year	Author/Country	Journal	Key Results from Kinematic Alignment (KA) Comparison to Mechanical Alignment (MA)	Overall
2014	Dossett/ USA	Bone & Joint J	KA provided better pain relief and restored better function and range of movement than MA	KA
2016	Waterson/ GBR	Bone & Joint J	KA comparable 1-year results to MA	
2017	Calliess/ DEU	KSSTA	KA WOMAC and combined Knee Society Score (KSS) better than MA	KA
2017	Matsumoto/ JPN	Bone & Joint J	KA joint line more parallel to floor during single- and double-leg standing than MA	KA
2017	Young/ NZL	CORR	KA 2-year patient-reported outcome scores no different from MA	
2019	Niki/ JPN	J Arthrop	In young active males, KA achieved higher functional activity than MA	KA
2019	McEwen/ AUS	J Arthrop	More participants preferred their KA joint. Fewer releases were required using the KA technique.	KA
2019	Laende/ CAN	Bone & Joint J	KA had acceptable tibial component migration, indicating stable fixation	KA

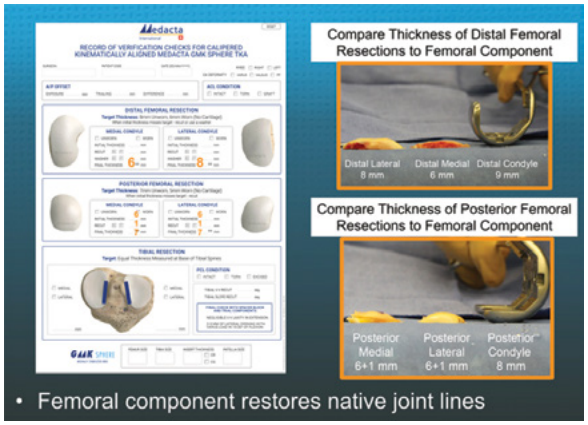
02 The table summarizes the year, author/country, journal of publication, and principle results of eight randomized and case-controlled trials, published between 2012 and 2019, that compared kinematic and mechanical alignment. Six studies showed that kinematic alignment restored better motion, better alignment, better clinical outcomes, and comparable tibial component migration when compared with mechanical alignment. The studies by Waterson and Young, which showed comparable outcomes, included only patients with small deformities and set limits on the degree of postoperative correction, which adulterated the testing of kinematic alignment.

Calipered Kinematic Alignment is FDA and CE Approved

In 2018, one implant company received FDA and CE approval for the "calipered" kinematic alignment technique with use of a medial stabilized ball-and-socket design and a flat lateral compartment design as described by Freeman and Pinskerova. The medial stabilized design can function with either a PCL-retaining (CR) or PCL-substituting (CS) insert (GMK Sphere; Medacta) (Fig. 3).



03 The left images show the tibiofemoral relationships in the medial and lateral compartments of the native knee in full extension and full extension, with the medial femoral condyle hardly moving (orange square) and the lateral femoral condyle rolling posterior in full flexion (orange rectangle). The right images show the design of the CR insert, which features a medial ball-and-socket and a lateral flat surface without a posterior rim. The use of this medial-stabilized implant design is a promising strategy for promoting anteroposterior stability and reducing the risk of late tibial component failure resulting from posterior rim wear of the insert.



04 The composite of images shows the verification worksheet (left) and the millimeter recordings of the thicknesses of the distal and posterior femoral bone resections compared with those of the condyles of the femoral component (right). The femoral component is kinematically aligned when the femoral resections match the thicknesses of the condyles of the femoral component within ± 0.5 mm after compensating for ~1 mm from the loss of bone from the kerf of the saw blade and 2 mm for cartilage loss.

The regulatory agencies mandated the use of caliper measurements of the bone resections and tibiofemoral relationships and completion of a series of intraoperative verification checks to confirm precise restoration of the native joint lines of the femur to within ±0.5 mm (Figure 4).

The caliper measurements and verifications function as quality-control methods that more accurately set the femoral and tibial components coincident to the native joint lines than the use of patient-specific, navigational, and robotic instrumentation that sets the components perpendicular to the femoral and tibial mechanical axes (Figure 4)[1].

Calipered Surgical Technique with Intraoperative Verification Checks

Watching a narrated video is one efficient method for learning the surgical steps of calipered kinematic alignment and the intraoperative decisions that restore the native tibial compartments without ligament release. Briefly, the distal femoral cuts are made, resecting precisely the thickness of the components and allowing for cartilage loss and the kerf of the saw blade. The same process is carried out for the posterior parts of the femoral condyles. When a CR insert is used, the tibial resection should restore the native varus-valgus angulation and posterior slope of the plane of the native proximal tibial joint line. All cuts are measured and checked and are adjusted when necessary. The anteroposterior axis of a properly designed and anatomically shaped tibial baseplate is oriented parallel to the flexion-extension plane of the native knee when best-fit to the cortical boundary of the tibial resection.

The flexion-extension plane is perpendicular to the transverse axis of the native femur and the distal and posterior femoral joint lines.

Calipered Kinematic Alignment for Total Knee Arthroplasty

The anterior center of the kinematically aligned baseplate is, on average, closer to the medial border and not the medial one-third of the tibial tubercle, with some variability. The kinematic alignment technique does not refer to mechanical alignment targets such as the mechanical and anatomical axes in the femur and tibia in the coronal plane or the transepicondylar axis and Whiteside's line in the axial plane.

After the insertion of spacer blocks and the introduction of trial components, knee balancing is performed by adjusting the plane of the tibial resection and the insert thickness and by following the six corrective measures outlined in the decision tree depicted in Figure 5. In knees with severe flexion contractures, the contracted posterior capsule is released; releasing ligaments is not an option. Tightness in the medial or lateral gap in full extension is corrected by cutting a 1°–2° wedge from the proximal part of the tibia. A rectangular extension space with negligible varus and valgus laxities restores the laxities of the native knee. When the PCL is incompetent and the knee is tight in extension and loose in flexion, the tibial slope should be reduced to tighten the flexion space. When reduction of the slope is not an option, 2 mm of additional bone should be resected from the distal part of the femur; however, this option is a non-kinematic and least-preferred compromise that raises the femoral joint line. Experimental and surgical experience suggests that bone corrections in increments of 1–2 mm or 1°–2° restore the native tibial compartment forces without the need for an intraoperative force sensor built into a disposable, one-time use, tibial insert[2].

DECISION-TREE FOR BALANCING A CALIPERED KINEMATICALLY ALIGNED CR TKA

Tight in Flexion & Extension	Tight in Flexion Well-Balanced in Extension	Tight in Extension Well-Balanced in Flexion	Well-Balanced in Extension and Loose in Flexion	Tight Medial & Loose Lateral in Extension	Tight Lateral and Loose Medial in Extension
Recut tibia and remove 1-2mm more bone.	Increase posterior slope until exposure A-P offset is restored at 90° of flexion.	Remove posterior osteophytes. Strip posterior capsule. Insert trial components & gently manipulate knee into extension.	Add thicker insert and recheck knee extends fully. When knee does not fully extend check PCL tension. When PCL is incompetent use **GMK Sphere CS** Insert.	Remove medial osteophytes. Reassess. Recut tibia in 1-2° more varus. Insert 1 mm thicker insert.	Remove lateral osteophytes. Reassess. Recut tibia in 1-2° more valgus. Insert 1 mm thicker insert.

05 Six-step decision tree for balancing a calipered kinematically aligned TKA when a PCR-retaining insert (CR) is used. Fine-tuning the varus-valgus inclination and posterior slope of the plane of the tibial resection and adjusting the insert thickness restores the native laxities of the extension and trapezoidal flexion space and the native tibial compartment forces without ligament releases.

Long-Term Outcome and Causes of Failure of Calipered Kinematically Aligned TKA

Calipered kinematic alignment that embraces the natural morphology and kinematics of the knee provides comparable or better long-term implant survival in comparison with mechanical alignment.

In a 10-year follow-up study of 222 knees that were treated with kinematic alignment, without inclusion restrictions based on the preoperative deformity and without limiting the degree of postoperative correction, my colleagues and I showed a 98.4% rate of aseptic implant survivorship, despite a high proportion of knees being aligned outside the recommended limits according to mechanical alignment criteria[3].

According to mechanical alignment criteria (which do not apply to kinematic alignment), 27% of limbs were aligned outside of ±3° from the mechanical axis (mostly in varus), with up to 6° of varus inclination of the tibial component from the tibial mechanical axis. However, these deviations had no adverse effects on implant survival and clinical outcomes because restoring the native tibial joint lines reduces the adduction moment and medial stresses during gait compared with mechanical alignment, as reported by Niki et al. in 2018.

The primary cause of early tibial component failure after calipered kinematically aligned TKA with use of CR implant designs is failure to restore the native slope. Deviation of ≥5° from the native slope may cause posterior overload and failure resulting from posterior subsidence of the tibial baseplate or posterior rim wear of the insert within the first 2–5 years after the index procedure[4]. The 0.3% incidence of tibial component failure after kinematic alignment is four times lower than the 1.3% rate of revision after mechanical alignment for varus overload reported by Berend et al. in 2004. The mechanism of late tibial component failure after nine years is posterior rim wear of the insert resulting from excessive anterior translation of the tibia or posterior rollback following the use of non-medial-stabilized implant designs that function as ACL and partial meniscal deficient knees (Nicolet-Petersen, KSSTA, 2019). Because of the negligible risk of tibial component failure due to varus overload after kinematic alignment TKA, there is no reason to restrict inclusion on the basis of the preoperative deformity or to apply restrictions on the postoperative correction from the native femoral and tibial joint lines[3].

Calipered Kinematic Alignment Restores Native Tibial Compartment Forces

In vivo, calipered kinematically aligned TKA performed with a CR implant design without ligament release restores medial and lateral tibial compartment forces comparable with those of the native knee. In contrast, mechanical alignment does not restore native forces even after ligament release. The measured resection and gap-balancing mechanical alignment techniques checked with navigation result in medial compartment forces that are 3 to 4 times higher and lateral compartment forces that are 5 to 6 times higher than those in the calipered kinematically aligned TKA and the native knee. Therefore, the use of kinematic alignment, restoration of the native slope, and the use of a medial stabilized implant design are strategies for reducing the risks of early and late tibial component failure resulting from posterior overload.

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Calipered Kinematic Alignment for Total Knee Arthroplasty

Benefits from Performing Calipered Kinematic Alignment

One convincing test for learning the benefits of calipered kinematic alignment is to use the technique for patients who have had a previous mechanically aligned TKA in the contralateral limb. In a study of 78 patients with a previous mechanically aligned TKA in the contralateral limb, my colleagues and I reported a 15-point higher Forgotten Joint Score in the knee with the calipered kinematically aligned TKA and found that the favorite and fastest recovering knee was more often than not the one with kinematic alignment[5]. In my opinion, the calipered technique, which relies on millimeter measurements and verification checks for restoring the native or pre-arthritic joint lines, is more reproducible than the use of robotics, navigation, and patient-specific instrumentation for achieving a mechanical axis for the limb.

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Dr. Howell is a Consultant for Medacta and receives royalties for Intellectual Property.

Commentary

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I read with great interest the article by Dr. Stephen Howell regarding "Calipered Kinematic Alignment" in TKA. Dr. Howell has been a passionate advocate of this technique for many years, and his article very nicely outlines the theoretical basis for this technique and supporting basic-science evidence. More importantly, he has personally taken this theoretical concept and successfully studied its practical application in several studies over many years. There is no doubt that the increased interest and enthusiasm for this technique around the world has been in no small part due to Dr. Howell's research, presentations, and publications in this area. The conclusion, as stated in the title, is that this technique is what you should use "when you want the best result." The main question at this stage is whether, based on a critical review of all available evidence, this conclusion is the unequivocal message, or, alternatively, whether we need to continue good-quality research and debate around alignment strategies in TKR?

All scientists understand the principle of skepticism toward new ideas, the fundamental principle being that the onus is on the proposer to provide good-quality evidence for the idea before the skepticism can be erased. The challenge is finding the right balance between (1) remaining skeptical in the face of overwhelming evidence and (2) letting one's enthusiasm for an idea subtly remove the need for ongoing skepticism. In this case, I believe that a good deal of the original skepticism and concern around kinematic alignment (KA) has been reduced by good research, much of which has been done by Dr. Howell, but I do not personally believe that the level of evidence has reached the point of being unequivocal.

We all tend to selectively find and review literature in a way that supports our theories. Dr. Howell reports that 6 of 8 trials showed better results with KA and states that the 2 studies that did not demonstrate favorable results had "adulterated" the testing of KA. That assessment may seem a bit harsh to the relevant authors, whereas authors who reported favorable results seem to have been treated somewhat less harshly. A closer examination of the conclusions of the latter articles indicates that they certainly are not unequivocally in favor of KA. Callies et al. found better overall results in association with KA but also reported more outliers with poor outcomes in the KA group. Niki et al. found better functional scores in association with KA but did not report improved patient satisfaction. McEwen et al., in a bilateral study, found that more patients preferred the knee on the KA side but also found that half of the patients actually had no preference.

My simple interpretation of these findings is that KA certainly seems to have benefits for a substantial proportion of patients, but not all patients, and that it also seems to have some limitations that may need to be considered. It may be that those studies that were said to "adulterate" the testing of KA were simply applying these limits appropriately. Either way, I believe that the current literature is far from supporting the notion that KA is unequivocally the "best" strategy for every patient and that ongoing critical research and analysis from multiple centers is to be encouraged.

Along these lines, can we actually say that one particular alignment philosophy is the perfect one for each individual? Dr. Howell seems to firmly believe that KA is the ideal strategy, whereas others firmly believe that mechanical alignment (MA) is the ideal strategy. Can we really be this dogmatic? Or is it possible that there are different "ideal" strategies for different patients? Interestingly, in his "decision tree," Dr. Howell actually shows that despite performing calipered cuts to match anatomy in KA, there are 6 possible scenarios in which "fine tuning" may be required, in many cases departing further from the KA concept to achieve the best result. Surely, the need for these additional options is evidence that simply performing calipered cuts to reproduce the joint line in every patient does not always produce the "best result" and that KA is a philosophy that has limitations, like many other alignment philosophies, and is not the exclusive panacea for patients who are dissatisfied after a previous TKA.

The discussion around "technological offerings such as robotics, navigation, and patient-specific instrumentation" is also interesting in that the article implies that the use of these technologies is somehow linked to MA. I think it is fair to say that these technologies are simply tools that surgeons may choose to use in order to achieve alignment more accurately, regardless of whether that alignment is achieved with KA, MA, or some other strategy. Indeed, reproducing a patient's joint line and original anatomy may be more accurately achieved with use of improved technology around image-based navigation and anatomical analysis than with use of calipers on joints damaged by arthritis. In his closing paragraph, Dr. Howell suggests that the calipered technique is more accurate than robotics or navigation, which seems surprising, and I'm not aware of good comparative studies that have investigated this question.

Another interesting topic in the discussion is the use of a medially stabilized design. Although such a design has theoretical benefits, it is unclear why, having established excellent outcomes and survival with cruciate-retaining (CR) implants, there is a need to change implant design. No doubt there will be future studies that will carefully examine whether or not this change in implant produces the desired improvement in outcomes, but it certainly will be hard to improve on the already reported excellent outcomes.

So, are we at a point where we can say that all surgeons should use calipered KA in order to get the best result? Personally, I think that the KA philosophy is an excellent concept, and, having followed these principles myself for several years (after having used MA for many years), I am for the most part pleased with the results. I remain to be convinced that KA is the one solution for patient dissatisfaction after TKA, which we all know is multifactorial, and I do not believe that it is a "one size fits all" solution but rather a technique that has a sound scientific theoretical basis and can certainly achieve excellent results in the majority of patients. Further clarity is required around the potential limitations, particularly in patients with more abnormal anatomy, and I believe that more independent evidence is required before we can say whether it is indeed the "best" alignment philosophy for all scenarios or whether surgeons need to consider different strategies for different scenarios. Careful patient and implant selection, good surgical technique, and well-implemented rehabilitation strategies remain the cornerstone of successful outcomes. Ongoing high-quality research and critical analysis of all subsequent presentations and publications, should lead to predictable, evidence-based improvements.

Quadriceps Autograft in Primary ACL Reconstruction: An Evidence-Based Synthesis

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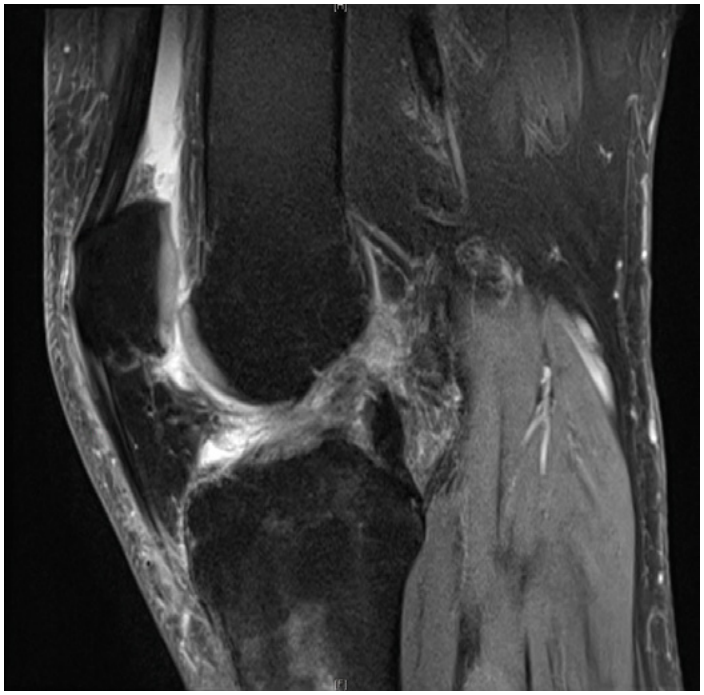
Change is coming. In fact, "change," often framed as "innovation," remains the only constant in the ever-evolving world of health care. In sports medicine, nowhere is change more evident than in the diagnosis and treatment of anterior cruciate ligament (ACL) injuries. Despite continued technical improvements and technological innovations, those of us in the orthopaedic sports medicine community have been humbled.

We have been humbled by the high failure rates and less-than-ideal rates of return to the preinjury level of activity that we have observed following ACL reconstruction – particularly among our young, most active (and arguably high-risk) athletes.

These disappointing results have inspired some of the thought leaders in our field to identify, and examine critically, all facets of this all-too-common, and ever-increasing, injury. But where the correct answers lie remains elusive, with >21,000 peer-reviewed studies and a wonderfully curated ISAKOS evidence-based textbook devoted to such ongoing controversies as whether we should focus on factors such as injury-prevention programs, surgical timing, concomitant procedures (i.e., osteotomies and/or lateral extra-articular tenodesis), bone morphology, or graft choice, to name a few. Herein, we focus on the hotly debated and relative influence of graft choice, with a special focus on the quadriceps tendon (QT) autograft.

Although there often exists an inherent skepticism regarding the adoption of new technology and/or techniques in surgery, we can rest assured that employing the QT is, in fact, not new. The use of this graft for knee ligament reconstruction dates back >40 years and has been backed by the strong work of such pioneers in the field as Professors Marshall, Kornblatt, Blauth, Yasuda, Fulkerson, Staubli, Fu, Fink, and Xerogeanes. Yet, for reasons identified only recently, the QT has been dwarfed in popularity in comparison with the hamstring tendon (HT) and/or bone-patellar tendon-bone (BPTB) options in the primary setting. Evidence-based medicine and patient-centered care do not need to be mutually exclusive. Often in the revision (or "salvage") setting, the QT remains popular. But why? Those who use BPTB grafts at the time of the index operation cite a number of arguments in favor of their approach, including bone-to-bone healing, rigid initial fixation techniques, low re-rupture rates, and intact hamstrings (which can serve as a secondary knee stabilizer postoperatively). Conversely, those who favor the HT at the time of the index procedure cite the advantages of lower donor-site morbidity, preservation of the native extensor mechanism, lower rates of late osteoarthrosis, and/or avoidance of the dreaded graft-tunnel mismatch.

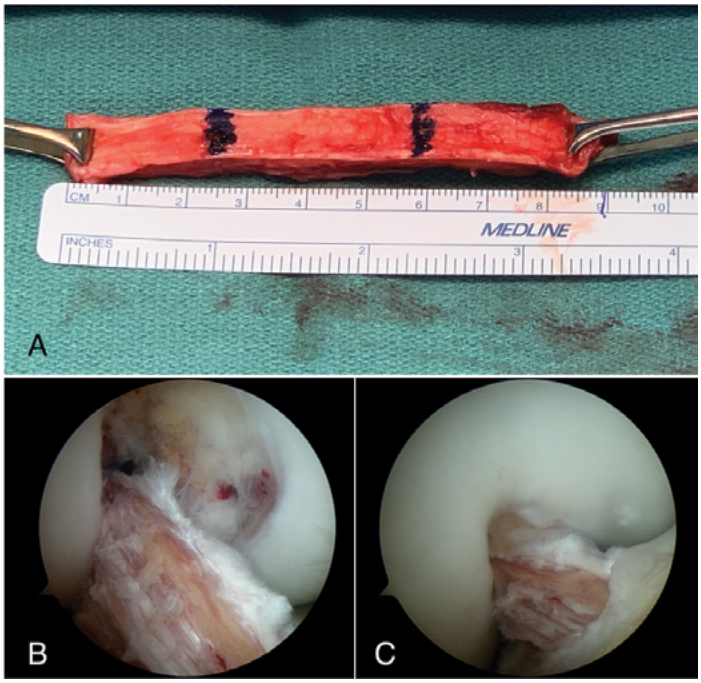
However, QT autografts offer a substantial range of advantages that have led to their re-emergence. Specifically, QT grafts can be reliably templated from preoperative magnetic resonance imaging (MRI) scans (Fig. 1); harvested in an open, mini-open, or arthroscopic-assisted / minimally invasive fashion[1]; (3) harvested as a full or partial-thickness graft, with or without a bone block (Fig. 2); used with a host of available fixation options; and (4) prepared for a single-bundle or double-bundle technique. Moreover, QT grafts are amenable to transtibial, anatomical, and / or all-inside techniques. Given these proposed advantages, an evidence-based approach can be used to guide their adoption.



01 Midsagittal MRI scan of an ACL-deficient knee, used for preoperative templating of a QT graft. QT thickness is measured 3 cm proximal to the proximal pole of the patella. In this case, the thickness was templated at 9.8 mm, compared with the 6.1-mm patellar tendon.

The >600 peer-reviewed publications on the topic—a third of which have been published within the past 5 years—are evidence that the QT is gaining popularity[2]. In fact, this topic has facilitated the formation of the International Quadriceps Tendon Interest (IQTI) Group, the main objective of which is to globally disseminate clinical and research expertise regarding the use of the QT for knee ligament procedures.

However, there remains an undetermined learning curve associated with harvest and preparation that may pose a barrier to broader implementation. From an evidence perspective, surgeons should take comfort in a recent, methodologically sound meta-analysis of 27 studies involving 2,856 ACL patients, which demonstrated comparable clinical and functional outcomes and graft survival rates in comparison with BPTB and HT autografts[3].



02 All-soft-tissue, full-thickness quadriceps tendon autograft.
02A Photograph of the graft before preparation with a suspensory device, with appropriate markings for length of tibial and femoral tunnels.
02B Intraoperative arthroscopic image of the graft, with knee in 90° of flexion.
02C Intraoperative arthroscopic image of the same graft, with knee in 10° of flexion.

Moreover, the study demonstrated significantly less harvest-site pain in comparison with BPTB autograft and better functional outcome scores in comparison with HT autograft. Since then, a wealth of studies, most with >2 years of outcomes data, have corroborating these findings. One also must acknowledge that, as a result of the immediate access to up-to-date literature that the digital age affords, patients are becoming increasingly technologically savvy, aware, and invested participants in their treatment decisions. Inevitably, patients will present to their surgeons requesting the QT graft, and, in some areas, are already doing so. These motivators, taken together, support our recommendation that the QT should become part of the armamentarium for any joint-preservation knee surgeon. That said, highlighting some of the evidence surrounding its use is paramount.

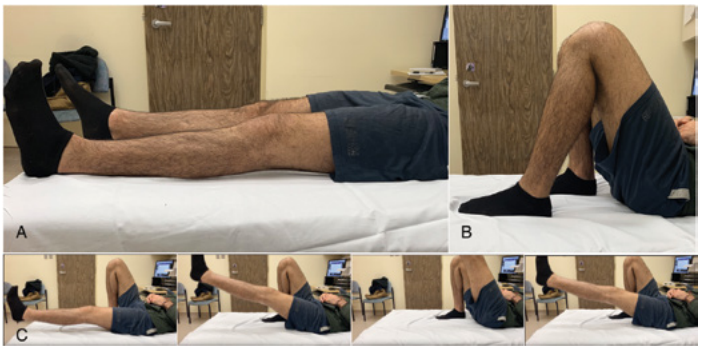
Quadriceps Autograft in Primary ACL Reconstruction: An Evidence-Based Synthesis

From a research perspective, as mentioned previously, the QT can be harvested with or without a patellar bone block. While the pros and cons of each method are beyond the scope of this article, our group has examined this topic in a systematic review of the literature that is currently under review. Our findings point to the utility of an all-soft-tissue QT autograft in the setting of primary ACL reconstruction: across 32 studies involving 2001 patients with a mean age of 29.1 years (range, 15–59 years) and a mean duration of follow-up of 35.7 months, knee outcome scores and return-to-sport rates were similar between patients who underwent reconstruction with both QT preparations (unpublished data). Although the use of a bone block theoretically potentiates faster healing and graft integration, these proposed advantages are not captured in any clinically meaningful way as all patients initiate immediate weight-bearing and range-of-motion protocols and are not necessarily cleared for return to sport sooner. We employ a bone block-QT graft in specific scenarios, such as cases in which the length of an all-soft-tissue graft is inadequate (rare) or cases in which bone is required in the revision setting. Graft integration is facilitated with the all-soft-tissue option by reaming tunnels 0.5 cm less than the graft diameter, and subsequently dilating to the graft diameter, to ensure complete socket fill and interference fit.

In another systematic review, our group investigated types of QT graft fixation with either suspensory or aperture technologies. That review demonstrated that, following primary ACL reconstruction, QT grafts appear to have a short-term failure rate of 3%, independent of fixation method, which is on-par with other graft re-rupture rates. It would appear that suspensory or aperture fixation for both the femoral and tibial tunnels are equally effective.

Moreover, our group not only highlighted that all dimensions of the QT graft can be easily predicted from preoperative MRI studies—an important consideration for those who value graft diameter as a predictive factor for success — but also demonstrated, in yet another systematic review of 20 studies involving 1,212 patients, that there were no differences between full-thickness and partial-thickness grafts in terms of outcomes or complications.

From a rehabilitation perspective, functional targets exist, especially early, to ensure optimal recovery and performance. Hindrances to achieving these milestones include, but are not limited to, perceived pain, the presence of edema, muscle inhibition, and movement limitations. It has been our experience that patients managed with QT grafts receive the "best of both worlds," experiencing less morbidity (i.e., anterior knee pain) while achieving both functional milestones and recovery of quadriceps strength quickly (Fig. 3). While we are currently studying this topic from a kinesiographic perspective, we are encouraged that our experience has also been echoed in the literature.



03 Range-of-motion and extension testing 4 weeks after ACL reconstruction with an all-soft-tissue QT autograft.
03A Maximum extension.
03B Maximum flexion.
03C Extension testing demonstrating no extensor lag.

A recent study from the Danish Knee Ligament Registry showed higher revision rates following primary ACL reconstructions performed with use of QT autograft as compared with BPTB and HT[4]. In that study, fewer ACL reconstructions were performed with QT than with either BPTB or HT (531, 1,835, and 14,213 procedures, respectively). In view of those numbers, the issue of a learning curve must be considered both by those who use this graft option as well as those who review the literature.

As orthopaedic surgeons, we must answer the call to work collaboratively and address key controversies with high-powered, well-designed, blinded, global randomized-control trials (RCTs) with long-term follow-up and intention-to-treat analyses. Indeed, it is largely through these efforts that causative inferences can be made regarding the effect of a treatment on a particular outcome.

To this end, we are encouraged by the recent findings of Professor Lind's prospective RCT, published in February 2020, which concluded that "The QT graft could be a better graft choice for ACLR"[5], and we eagerly anticipate the results from the STABILITY 2 RCT in adult ACL patients. We have no doubt that the aforementioned studies will continue to provide some insight into important unanswered questions in the young adult population undergoing ACL reconstruction.

However, there continues to be a stark lack of high-quality evidence in the skeletally immature ACL population, particularly with respect to graft choice. To date, the use of the QT as an autograft option for primary pediatric ACL reconstruction has not been well studied. Recent case series of pediatric patients who have been managed with a QT autograft for ACL reconstruction are promising. However, until recently, no RCT has endeavoured to examine the efficacy of the QT autograft for primary ACL reconstruction in pediatric patients.

Investigators at McMaster University are steering recruitment efforts for the pilot Soft-tissue Quadriceps Autograft ACL-reconstruction in the Skeletally-immature versus Hamstrings (SQuASH) study. That effort aims to demonstrate the feasibility of a global RCT that will evaluate the efficacy of all-soft-tissue QT versus HT autografts in terms of reoperation, return to sport, and knee function among pediatric patients managed surgically for ACL insufficiency.

In summary, the field of ACL reconstruction, as we know it, is changing. There is re-emerging clinical evidence to support the broader adoption and integration of the QT in the setting of primary ACL reconstruction. However, higher-quality studies are a fundamental step to arrive at widespread implementation and to evaluate long-term efficacy. We currently offer the QT as an option for all patient populations undergoing ACL reconstruction, regardless of age, activity status, sex, body habitus, or setting. We eagerly anticipate the findings from such focused groups as the International Quadriceps Tendon Interest Group, and perhaps with more evidence, we can collectively improve our decision-making algorithms.

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Difficult Elbow Problems: Heterotopic Ossification and Calcification

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Introduction

The first ISAKOS webinar on elbow surgery was broadcast worldwide on June 5, 2020. Chairmen Dr. Pederzini and Dr. Bhatia asked opinion leaders in the elbow field to discuss heterotopic ossification and its possible treatments.

Classification

Pathological bone formation around the elbow may assume different forms:

- Calcification: a deposit of calcium inside the capsule or the ligaments, without trabecular structure.
- Ossification: an osseous metaplasia starting from the bone.
- Myositis ossificans: bone formation inside the muscles.
- Myositis proliferans: fibroblast proliferation inside the muscles, without osseous metaplasia.
- Fibrodysplasia ossificans progressiva: a rare congenital condition.
- Tumors.

The most frequently used classification system is the functional classification proposed by Hastings and Graham[1] (Table I).

TABLE I. Classification System of Hastings and Graham

CLASS I	Radiographic heterotopic ossification without functional limitations
CLASS II	Radiographic heterotopic ossification with subtotal functional limitations **IIA:** Limited flexion-extension **IIB:** Limited pronation-supination **IIC:** Limited function in both planes
CLASS III	Radiographic and functional ankylosis **IIIA:** Ankylosis in flexion-extension **IIIB:** Ankylosis in pronation-supination **IIIC:** Ankylosis in both planes

Etiopathogenesis and Risk Factors

The literature suggests that heterotopic ossification (HO) lesions tend to grow over a period of up to 3 weeks after onset and mature in about 3 to 6 months. These observations may lead one to think that the absence of HO on radiographs 2 weeks after trauma or surgery could be a good prognostic factor. There is disagreement in the literature with regard to the use of pharmacological prophylaxis after an acute event; if used, such treatment seems to be effective immediately after trauma but may not have a role in limiting HO once it has been noticed.

Although the existing literature provides no definitive answer, the etiopathogenesis of HO is likely multifactorial. The neurogenic mechanism seems to be the most promising explanation. The trigger is an external cause that leads to the release of bone morphogenetic protein (BMP), the activation of afferent sensory neurons for pain, and the recruitment of mast cells to peripheral nerves.

Metalloproteases seem to stimulate the stem cells from the neural crest which, in a hypoxic environment (e.g. muscle necrosis) leads to pathological bone formations[2]. Patients affected by transient neuropathies are much more affected by HO than others.

Some patients may have a genetic predisposition to develop HO. Moore-Lotridge et al.[3] recently proposed the "two hit mechanism," whereby HO can result from insufficient protection against nanohydroxyapatite deposits with a failure of macrophage-mediated regression.

Many risk factors have been highlighted in the literature. Some risk factors are recurrent and could change the surgeon's approach to elbow surgery. Delays (>48 hours) in elbow lesion treatment, prolonged immobilization, and the performance of multiple reduction steps are factors that may be associated with the development of HO. Fracture-dislocation patterns, burns, and central nervous system injuries have been correlated with HO development, but physicians cannot directly change these factors.

01 Radiograph showing HO in a preserved joint.

02 Radiograph showing HO in a joint with progressive osteoarthritis.

Surgical Treatment

The surgical strategy (open or arthroscopic) varies according to the anatomical location and extent of ectopic bone formation, the presence of capsular contracture, previous surgical incisions, muscle and tendon deficiencies, the proximity of nerves, and skin problems[4]. The surgical strategy is also affected by joint incongruities and bone deformities. A variety of different techniques can be used to restore range of motion (ROM), ranging from simple HO resection and soft-tissue release in cases of a preserved joint (Figs. 1 and 2) to interposition arthroplasty or total elbow arthroplasty in cases of irreparable joint damage5 (Figs. 3A, 3B, and 3C). Preoperative radiographs, CT scans, and MRI scans can be useful to define the surgical plan.

03A Preoperative radiograph.
03B Postoperative radiographs showing joint incongruences or bone deformities and early HO.
03C Radiographs made at 3 and 6 months, showing massive HO with complete elbow ankylosis.
Figs. 3-A, 3-B, and 3-C Case 1, a 60-year-old man with a complex fracture of the right elbow.

Key Principles of Surgical HO Resection

- Preserve integrity of soft tissue and articular surfaces
- Protect neurovascular structures
- Excise HO bone formations
- Release anterior and posterior capsules
- Preserve or restore collateral ligaments
- Check functional ROM and stability at the end of the procedure

Open Technique

It is useful to place the patient in the supine position with the arm on the chest and with a pillow under the forearm. The shoulder should be free to rotate in order to change the position of the elbow and to pass easily from medial to lateral or anterior to posterior compartments.

Difficult Elbow Problems: Heterotopic Ossification and Calcification

Skin Incision

Single or multiple skin incisions can be used; the choice depends on the location and extent of the HO. A precise preoperative plan based on radiographs and CT scans helps to define the best approach.

Medial and lateral exposure can be performed through two single incisions or a single posterior skin incision (known as the "global" approach to the elbow). A midline posterior incision is typically straight, passing few centimeters medial or lateral to the tip of the olecranon. Then, two full-thickness fasciocutaneous flaps are elevated from the skin to the fascia of the triceps, preserving the blood supply and reducing the risk of cutaneous neuroma. The ulnar nerve is identified proximally, and neurolysis or subcutaneous anteposition are advised, depending on the clinical symptoms and the location of the HO.

Lateral Exposure

The "column procedure" for simple release of extra-articular elbow contracture, described by Morrey, can be useful for HO excision as it allows for exposure of both the posterior and anterior compartments of the elbow joint[5]. Exposure and release of the anterior compartment can be performed by elevating the brachioradialis and extensor carpi radialis longus muscles from the anterior aspect of the lateral epicondyle. The posterior compartment is exposed, and the triceps is released and elevated from the posterior humeral surface.

Medial Exposure

The medial approach begins with exposure of the posterior joint capsule and olecranon fossa from the medial side following exposure of the ulnar nerve. The medial border of the triceps is elevated from the intermuscular septum and the medial epicondyle. The anteromedial release is performed though the internervous plane between the flexor carpi ulnaris (innervated by the ulnar nerve) and the flexor-pronator muscle (innervated by the median nerve). The common flexor-pronator origin can be elevated to improve exposure of anteromedial joint compartment.

Posterior Exposure

In cases of extensive posterior HO, a useful exposure to the distal part of the humerus is the bilaterotricipital or paratricipital approach described by Alonso-Llames, which involves the lateral and medial edges of the triceps. Another approach involves splitting the triceps tendon, preserving the medial olecranon insertion (proper tendon), and divaricating the muscle-tendon unit to expose the posterior compartment.

Proximal Radioulnar Synostosis

The anconeus and extensor carpi ulnaris complex are elevated from the ulna, with their origins from the lateral epicondyle being left intact. Alternatively, the Kocher approach can be used, thus creating an interval distal to the lateral epicondyle between the anconeus and the extensor carpi ulnaris. The subperiosteal dissection is carried along the proximal part of the ulna toward the anterolateral surface of the radius and to the base of the synostosis. If dissection continues distally, the release of the two heads of the supinator muscle from the ulna allows to improve the distance between the synostosis and the posterior interosseous nerve moving it medially inside the supinator muscle.

Arthroscopic Technique

Arthroscopic early excision (<6 weeks after the development of HO) has been suggested by some authors. Both anterior and posterior extensive ossifications can be easily removed during this early phase with a soft-tissue shaver because of the tenderness of metaplastic bone.

The procedure can be performed with the patient in the prone, supine, or lateral decubitus position. Distention of the joint with saline solution through the soft spot may not be an effective solution because of capsular retraction, but it is helpful to shift the anterior neurovascular structures away before introducing the trocar. The ulnar nerve has to be localized and, once a proximal anteromedial portal is established to visualize the anterior joint capsule, the proximal anterolateral portal is created with use of the outside-in technique. Anteriorly, the HO is usually located anterior to the capsule and posterior to the brachialis.

The first step is to assess the anterior compartment by performing the release of the anterior capsule from the humerus and then resecting the capsule until the HO is exposed. It is useful to establish a straight lateral portal with a switching stick (such as a retractor), which can be used to retract the brachialis away from the HO and protect the anterior neurovascular structures. Next, the HO is resected from top to bottom, with the shaver always staying posterior to the switching stick and brachialis muscle. Switching the arthroscope and the shaver can be useful for the removal of any remaining HO. In some cases, because of the presence of a thick capsule, anterior capsulectomy may be required. The capsulectomy is performed by trimming the proximal humeral capsule with the shaver and then using a basket forceps to complete the maneuver. It is useful to start about 1 cm proximal to the apex of the coronoid, first proceeding from lateral to medial and then proceeding in the opposite direction.

The posterior compartment is exposed with use of posterior central and lateral portals. Small incisions can be performed to visualize and protect the ulnar nerve before performing the next steps. The triceps muscle is elevated from the HO with use of a switching stick or a retractor through an additional posterior portal. The HO is usually resected starting from distal to proximal, with the shaver in the posterior central portal and the arthroscope in the posterior lateral portal. Before completing the procedure, it is important to obtain radiographic or fluoroscopic confirmation of complete removal of the HO.

Chronic HO (>6 months) can be removed arthroscopically, but sometimes, depending on the hardness of the metaplastic bone, it is not easy to obtain complete removal.

The proximal radioulnar synostosis can also be removed arthroscopically, with the radial nerve being protected with a retractor, by working around the radius anteriorly and using the distal biceps tendon as anatomical landmark.

In some cases, particularly those in which extensile HO is close to neurovascular structures, the use of a combination of arthroscopic and open techniques can be used to improve the safety of the procedure. In such cases, preoperative imaging is advised to assess the extent and location of HO and its relationship with the neurovascular structures.

Perioperative Strategies (Open or Arthroscopic)

Perioperative radiotherapy (700 rads seems to be the best choice), cryo-compression, immediate continuous passive motion, and assisted active motion are some of the suggested strategies to reduce the risk of recurrence and to obtain the best outcomes. Doxycycline and prednisone administration are currently administered to reduce the proinflammatory cytokines.

Outcomes

The reported outcomes of HO excision in terms of the recovery of a functional range of motion seem to be good, but the overall rate of complications (e.g., recurrence, fracture, infection, nerve palsies, wound complications) is around 20%. The rate of reoperation (including repeat excision of HO and nerve transposition) is around 10%4. The outcomes seem to be related to several factors, such as the extent of the HO, the timing of surgical excision (from 3 to 6 months), associated neurological contracture, and patient compliance with postoperative rehabilitation programs.

Conclusions

Excision of HO and release of soft-tissue contracture require knowledge of anatomy. Precise preoperative planning with use of radiographs, CT scans, and MRI scans is necessary in order to define not only the extent and location of the HO but also the joint congruency and associated bone deformity as well as the distance between the HO and neurovascular structures. The aim of the surgical procedure is to restore a functional range of motion and stability of the elbow. The choice of surgical technique (open, arthroscopic, or combined) is related to the extent and anatomical location of the HO, particularly with respect to its relationship with the neurovascular structures around the elbow. Salvage procedures such as interposition arthroplasty or total elbow arthroplasty are indicated in cases of irrecoverable joint incongruencies or bone deformities with progressive arthritic changes.

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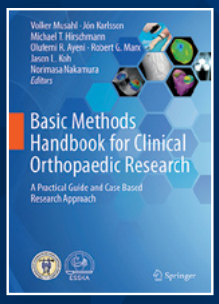

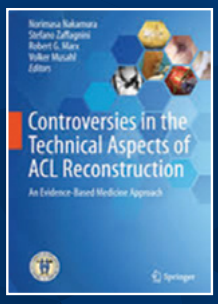

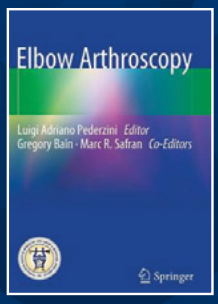

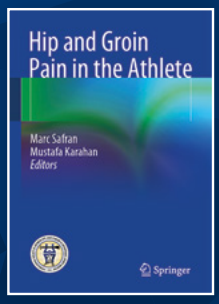

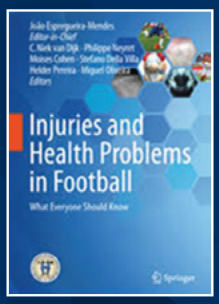

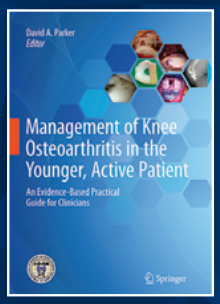

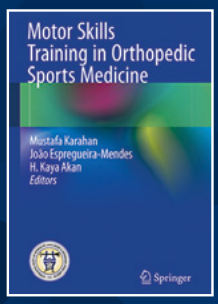

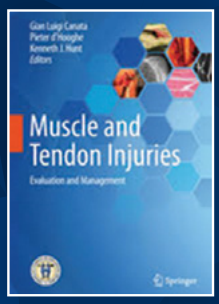

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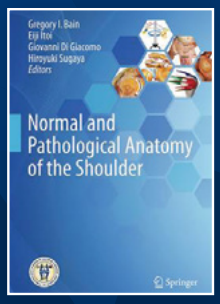
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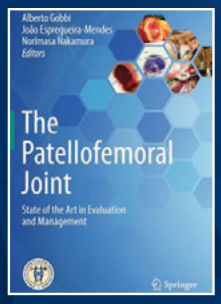
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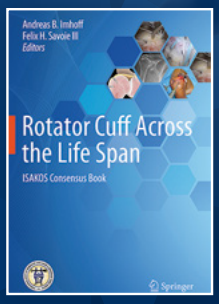
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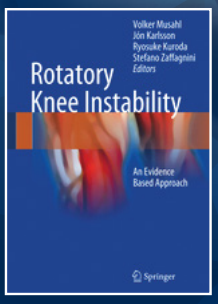
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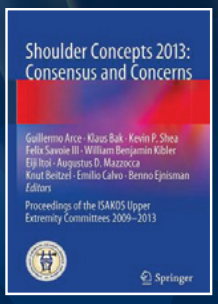
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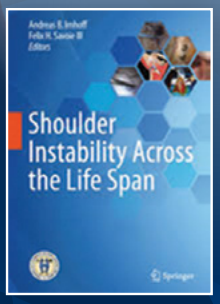
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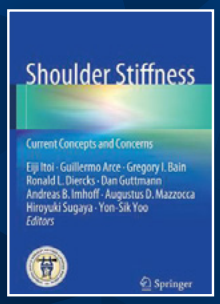
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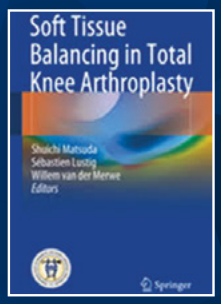
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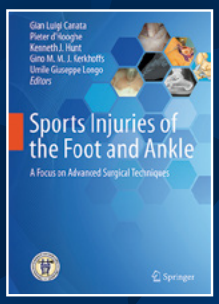
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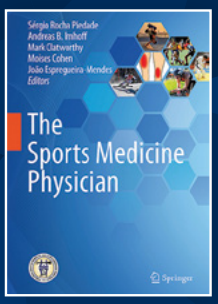
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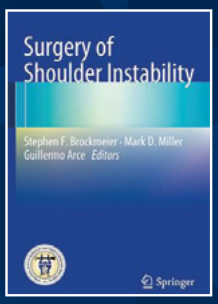
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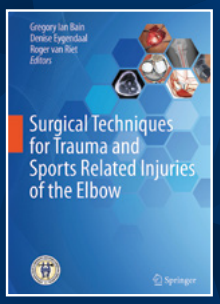
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ISAKOS Research Grants Drive Impactful Results

The ISAKOS Research Grants program was developed to provide ISAKOS members with a resource for funding the highest quality international research in arthroscopy, knee surgery and orthopaedic sports medicine. A call for grant submissions is announced every two years, highlighting four research categories: new researcher, osteoarthritis, clinical outcomes and countries with limited resources.

As the 2017–2019 grant cycle closes and the 2019–2021 research term is in full swing, ISAKOS is pleased to recognize outcomes and impact of the 2017–2019 research projects. 2017–2019 grant awardees included:

New Researcher

Development of Computer Tablet Software for Quantification of Scapular Motion During Clinical Assessment of Scapular Dyskinesia

Tryfon Totlis MD, PhD (GREECE)

After receiving the New Researcher grant, Dr. Totlis reported on publication of the study in the KSSTA journal, and commented on the impact of the ISAKOS grant funding:

> "In the current study, we adapted the PIVOT app (Impellia Co, Pittsburgh, PA, USA) to the shoulder attempting to track scapular dyskinesis. The most significant contribution of the ISAKOS grant to our work was the presence of a technician from Impellia in Greece during the trials. She offered valuable solutions to any difficulty we faced with the Pivot App use and function. The study concluded that the PIVOT app was efficient to record the amount of deviation of scapula medial border from the thoracic wall."

Osteoarthritis

Comparison of Tissue Engineered Construct (TEC) Derived of Human Stem Cells from Dental Pulp and Synovia on Articular Cartilage Regeneration

Tiago L. Fernandes MD, MSc, PhD (BRAZIL)

Dr. Fernandes reported that Osteoarthritis research grant funding from ISAKOS resulted in three publications and five presentations presented at national and international congresses related to the grant, commenting,

> "Regarding ISAKOS Osteoarthritis Grant, we've completed all experiments in 14 large animals translational model and we're currently analysing final data. Very interesting data was obtained in groups treated with Tissue Engineered Construct (TEC) for MOCART score in a 7-Tesla MR protocol. Some papers were published and presented internationally related to systematic reviews and methods, and a manuscript will be submitted to ISAKOS Journal. We've started ethics and scientific committee approvals for the clinical trial phase I/II study in humans based on our translational results of ISAKOS Osteoarthritis Grant. Thank you very much ISAKOS for all support and confidence till now!"

Clinical Outcomes

Cluster RCT of Implementation Strategies for ACL Injury Prevention

Robert G. Marx MD, MSc, FRCSC (USA)

Dr. Marx reported on outcomes from his Clinical Outcomes research, including two articles published in *JISAKOS* on the topic of ACL injury prevention, with a third currently under review.

> "The ISAKOS grant allowed us to carry out research that required hiring multiple data collectors who traveled to observe teams of athletes doing injury prevention exercises. Without the funding, we would have been unable to complete this research. We hope the results of our work will improve the way injury prevention programs are administered to young athletes in the future."

The ISAKOS Research Grants program is impactful and critical to the continuation of research for the future improvement of clinical care, and ISAKOS is grateful to our industry partner, Smith + Nephew, whose educational grant supports, in part, the ISAKOS Research Grants program."

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ISAKOS Launches Gender Diversity & Inclusion Task Force

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Diversity is essential for the creation of a strong and productive organization that maximizes the strengths and talents of all of its members. Similarly, a diverse leadership group with unique experiences and perspectives is better able to generate novel ideas and goals, contribute different approaches to an issue, and provide a fresh viewpoint to an organization.

The membership statistics for our society were reported in the latest edition of the *ISAKOS Newsletter*. There are currently 2,959 members of ISAKOS, of whom 106 (3.6%) are female. There are no women on the Executive Committee or the Board of Directors of ISAKOS. There are no female committee chairs. Currently, 11 female members are represented in a total of 14 of the 250 positions on the various ISAKOS committees. Three of the 26 members of the Editorial Board of the Journal of ISAKOS are women. In the history of the society, only two women have won named research awards at the ISAKOS Congress, four have been awarded a Patellofemoral Travelling Fellowship, and one has been awarded a Conference Scholarship.

The International Orthopaedic Diversity Alliance (IODA), led by Jenny Green, MD, an Australian hand and wrist surgeon, recently published an article in *Journal of Trauma and Orthopaedics* entitled "Diversity: Women in Orthopaedic Surgery—A Perspective From the International Orthopaedic Diversity Alliance."[1] This group collated the number of female surgeons from each of their country's societies and showed concerning numbers regarding female representation (Fig. 1).

HOW WE FARE (2019)*

RANK	COUNTRY	POPULATION (million)	ORTHOPAEDIC SURGEONS	SURGEON: POPULATION	FEMALE ORTHOPAEDIC SURGEONS	% OF FEMALE ORTHOPAEDIC SURGEONS
1	Estonia	1.3	110	1 : 12,045	29	26.4%
2	Sweden	10.1	1376	1 : 7,316	231	16.8%
3	Brunei	0.4	15	1: 28,666	2	13.3%
4	Canada	37.6	1659	1 : 22,658	199	12.0%
5	Colombia	50.3	2,020	1 : 24,900	208	10.3%
6	Malaysia	32.6	982	1 : 33,197	98	10.0%
7	Hong Kong	7.4	470	1 : 15,744	38	8.1%
8	Tanzania	50.0	118	1 : 423,728	9	7.6%
9	France	67.0	3,503	1 : 19,126	248	7.1%
10	Chile	18.9	794	1 : 23,803	49	6.2%
11	United States	329.1	27651	1 : 11,900	1673	6.1%
12	Indonesia	270.6	1000	1 : 252,897	54	5.4%
13	New Zealand	4.8	302	1 : 15,894	15	5.0%
14	Japan	126.7	21,275	1 : 5,955	1,040	4.9%
15	United Kingdom	66.9	2,960	1 : 22,591	141	4.8%
16	Australia	25.4	1,334	1 : 19,538	57	4.3%
17	Kosovo	1.8	78	1 : 23,076	3	3.8%
18	Thailand	69.6	2,430	1 : 28,641	92	3.8%
19	Philippines	108.1	1070	1 : 146,081	35	3.3%
20	Singapore	5.8	253	1 : 22,924	8	3.2%
21	Kuwait	4.7	149	1 : 31,543	3	2.0%
22	Myanmar	54.1	500	1 : 108,200	10	2.0%
23	Sri Lanka	21.3	90	1 : 236,666	1	1.1%
24	Taiwan	23.7	1,982	1 : 11,957	20	1.0%
25	Korea	51.2	8227	1 : 6,223	67	0.8%
26	India	1,366.0	10,000	1 : 136,640	50	0.5%
27	Nepal	28.6	400	1 : 71,500	2	0.5%
28	Bangladesh	163.0	1,200	1 : 135,833	5	0.4%
29	Pakistan	216.5	1500	1 : 144,333	4	0.3%
30	Cambodia	16.5	100	1 : 165,000	0	0.0%
31	Laos	7.2	50	1 : 143,400	0	0.0%

* Data collected from each nation's Orthopaedic Association. Asia-Pacific data courtesy of PC Chye

01 Analysis of gender diversity by nation. (Reproduced from the *Journal of Orthopaedic Trauma* with permission from The British Orthopaedic Association.)

In that article, the authors explored the barriers to and advocacy efforts toward improving gender diversity and the evidence supporting these initiatives. They proposed a framework for improving gender diversity that challenges leadership to incorporate the following principles:

- Communicate and embed values, behaviors, and cultural norms for equity and inclusion.
- Ensure that recruitment and promotion processes are unbiased and involve diverse decision-makers.
- Create working models that support males and females with families.
- A visible and committed leadership.

One area of well-earned pride for ISAKOS is its commitment to addressing geographic and cultural diversity. Achieving gender diversity and inclusion represents the next challenge for societies such as ISAKOS as well as the entire orthopaedic community. Willem van der Merwe, MD, and David Parker, MD, along with the Executive Committee of ISAKOS, aim to address this challenge. To that end, and with full support from ISAKOS, the Gender Diversity and Inclusion Task Force has been established.

The task force consists of eighteen female members from North America, South America, Europe, Asia, and Asia-Pacific. Dr. Laurie Hiemstra is chair of the newly formed task force, with Drs. David Parker and Jason Koh serving as Executive liaisons.

Under the leadership of Dr. Hiemstra, the task force will guide ISAKOS in implementing and maintaining gender diversity and inclusion principles. Dr. Hiemstra is an orthopaedic surgeon specializing in sports medicine and arthroscopic surgery in Banff, Canada.

She is an Associate Professor of Orthopaedic surgery at the University of Calgary and serves as the Director of Research at Banff Sport Medicine Foundation. Dr. Hiemstra is an Executive Committee member of the Canadian Orthopaedic Association (COA) and the Arthroscopy Association of Canada (AAC). She currently serves on the COA Member Board of Directors. She recently was voted in as 2nd President-Elect of the COA and will be the first female president of the organization. Dr. Hiemstra is an active member of numerous orthopaedic societies and sports medicine organizations (COA, ESSKA, AANA, AAOS, AOSSM, AAC) in addition to ISAKOS, including the International Patellofemoral Study Group. She was the 2014 ISAKOS Patellofemoral Travelling Fellow and now serves on the Board of Directors of the Patellofemoral Foundation.

Dr. Hiemstra is passionate about diversity and increasing the representation of females in orthopaedic surgery and in leadership positions within the field of orthopaedics. She has been leading the gender diversity advocacy initiatives within the COA and now is continuing to do so at ISKAOS. In 2019, the *Journal of ISAKOS* published her article on the trends for women on the podium at the COA Annual Meeting.[2]

"To improve female representation in our society, we must first create a culture of equity and inclusivity," says Dr. Hiemstra. "We need to address the systematic disadvantages that exist for women in this male-dominated profession. By engaging female members and providing equality of opportunity, ISAKOS will be able to take full advantage of the diversity within its membership and become a stronger organization."

The first goal of the ISAKOS Gender Diversity and Inclusion Task Force is to increase the number of female members and improve engagement by highlighting the lack of gender diversity within the society. Increasing the number of female members and clearly demonstrating inclusivity and acceptance within all areas ISAKOS will help to reduce any potential negative perceptions regarding lack of inclusivity. Having more female participation in the organization not only will positively reinforce this progress but also will contribute a wealth of different experiences and innovative ideas to drive further change.

The second goal is to increase female representation in educational activities, the biannual Congress, and the executive structure of ISAKOS. The inclusion of a larger number of women in the ISAKOS scientific meetings and biannual Congress will create a wider range of ideas and viewpoints, and, as a result, improved teaching and learning for our members. As Julie Silver, MD, from Harvard University so eloquently says, "For any award (or position or lecture or role) in medicine, there are more than zero women who deserve it."

The 2021 Cape Town Congress is an excellent example of how a focus on achieving gender diversity can induce change. Under the leadership of Volker Musahl, MD, Mark Clatworthy, MD, and ISAKOS CEO Sue Reimbold, MA, Cape Town promises to be the most inclusive meeting to date, with the number of women participating in the Congress far exceeding those in previous years.

- The program in Cape Town anticipates 29 female speakers (compared with 13 of 832 in Cancun).
- There are up to 450 opportunities for podium paper presentations (compared with approximately 200 in Cancun).
- An Instructional Course Lecture entitled "Gender & Diversity — Meet the Experts" is scheduled for Wednesday, December 1, under the leadership of Dr. Liza Arendt. The panel includes Drs. Camilla Cohen Kaleka, Margaret Fok, Laurie Hiemstra, Magaly Iniguez, Jason Koh, and David Parker.

A reception is planned for the women members and attendees to provide a fun, interactive venue for the women of ISAKOS to meet each other, create and renew friendships, network, and make lasting contacts and connections.

As with all initiatives, the Gender Diversity and Inclusion Task Force cannot succeed without genuine support from male allies. The vision of the "#heforshe" leaders in ISAKOS (Willem van der Merwe, Guillermo Arce, David Parker, Jason Koh, Volker Musahl, and Mark Clatworthy) is extremely important. Working together toward a stronger, more diverse ISAKOS should be the goal of all of our members. We urge support, encouragement, and action for this important initiative.

Recommended Twitter Hashtags:

#ISAKOS	#gendergap
#womenofISAKOS	#ilooklikeasurgeon
#womeninortho	#genderequality
#diversityandinclusion	#diversitymatters
#womeninmedicine	#heforshe
#needherscience	#shecan
#womenleadership	#weareallortho

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1. Green J, Chye V, Hiemstra L, et al. Diversity: Women in orthopaedic surgery – a perspective from the International Orthopaedic Diversity Alliance. *Journal Of Trauma and Orthopaedics*. 2020;8(1):44-51. **2.** Hiemstra L, Wittman T, Mulpuri K, Vezina C, Kerslake S. Dissecting disparity: improvements towards gender parity in leadership and on the podium within the Canadian Orthopaedic Association. *Journal of ISAKOS: Joint Disorders & Orthopaedic Sports Medicine* 2019;4:227-232.

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Report from the ISAKOS Archives Committee

Per Renström MD, PhD,
Professor Emeritus
Karolinska Institutet Stockholm
Chair, ISAKOS Archives Committee
SWEDEN

The ISAKOS Archives Committee includes experienced and very committed ISAKOS members, including Roland P. Jakob, Switzerland, Deputy Chair; Ramon Cugat, Spain, Past Chair; John Bartlett, Australia; José F. Huylebroek, Belgium; Moises Cohen, Brazil, Deputy Chair; Gary G. Poehling, US; Masahiro Kurosaka, Japan; Peter T. Myers, Australia; Giancarlo Puddu, Italy; Barry R. Tietjens, New Zealand; Kathleen Rankin, Alexa Schenk and Michael Syrett, ISAKOS Office; and Per A. Renström, Sweden, Chair. Moises Cohen recently resigned because of his many commitments. This report was written by the Committee Chair for logistical reasons, but the members will be more active next time. This committee has met three times: once in person (during the ISAKOS congress in Cancun) and twice by video (during the fall of 2019 and on June 11, 2020). During this time, we have discussed how get hold of old material from the IAA, ISK, and ISAKOS and how to present it in the most compelling way in order to enable the ISAKOS membership to enjoy the history of these organizations. The Committee also identified a few new projects to work on, as described below.

ISAKOS at 25 Years

ISAKOS was founded in Hong Kong in 1995 at the combined IAA/ISK meeting. Both IAA and ISK were founded in the 1970s and developed rapidly into relevant and popular organizations with increasingly overlapping areas of interest. This overlap became increasingly apparent at the biannual meetings. Discussions about a merger started around 1983 and intensified over the following years. In 1995, at the Hong Kong unified meeting, the merger became a reality. This means that ISAKOS now is 25 years old.

In order to celebrate this milestone and establish the story behind the merger, a symposium has been planned. Although the celebration symposium originally was scheduled to be held at the ISAKOS Regional Meeting in Gothenburg in October 2020, that meeting has been cancelled because of the Covid-19 pandemic. The symposium, tentatively entitled "The Road to Create ISAKOS 25 Years Ago," will now take place during the ISAKOS World Congress in Cape Town, South Africa, to be held on November 27 through December 1, 2021.

The members of the panel will hopefully include D. Dandy, G. Poehling, and R. Jakob, with Per Renström and Marc Safran as moderators. This symposium promises to be a very interesting event. We need to learn from our history.

History of ISK and IAA

ISAKOS needs to make sure that we have a full history of ISK and IAA in our archives. Merv Cross from Australia has sent in extensive information about ISK, which is particularly valuable given that Dr. Cross was very active in ISK from the start. Some of this material relates to the origins of knee surgery in Australia and therefore is more specific to that country rather than being internationally focused. However, much of this valuable material relates to the merger of ISK and IAA. Dr. Cross also sent in a number of photographs, which will be incorporated into history of the ISK in the Archives section of the ISAKOS website. Ramon Cugat has revised the available ISK information, and the changes are currently being made by the ISAKOS office. For quite some time, Dr. Cugat has expressed concern about the lack of information that we have from the Board of Directors of ISK during the years 1981–1983 and 1983–1985. However, very recently, Giancarlo Puddu discovered that he was in possession of that information, allowing us to finally complete the historical timetable found in the Archives section of the website. We are very thankful indeed for this major contribution.

History of Arthroscopy and the Contributions of Dr. Watanabe Since 1958

Our Japanese colleagues, especially Dr. Watanabe, have been very instrumental the development of arthroscopy, and, indeed, of the arthroscope itself. Honorary ISAKOS member Dr. Moriya has donated extensive material, including videos on the history of Arthroscopy and Dr. Watanabe, to the ISAKOS archives (available at http://www.isakos.com/Archives/Video-Archives). The videos still need to be translated into English, and Dr. Kurosaka will work to make sure that this happens. The material on the history of arthroscopy is of great interest, and Dr. Kurosaka has agreed to work on a presentation together with his Japanese colleagues to be presented at an ISAKOS event in the future.

Legends and Giants

A symposium on History and Legends will be held during the Cape Town meeting in 2021. The speakers will include John Bartlett, John Bergfeld, Masahiro Kurosaka, Lars Peterson, and Savio Woo, and the Co-Chairs will be Peter Fowler and Per Renström. This symposium will include both global and also regional history, and number of legends and classic mentors will be showcased.

When an individual has done something great and worked for a cause their whole life, we tend to view that person as a giant in their field. The Committee has therefore decided to try to identify some real giants in Orthopaedic Sports Medicine who will be contacted for an interview.

Report from the ISAKOS Archives Committee

To ensure that these interviews run smoothly, a learned colleague who is willing to prepare a list of questions will also be identified. Michael Syrett, our new Digital and Multimedia Content Coordinator, will coordinate these interviews with the help of Kathleen. Mr. Syrett has suggested a "buddy system," whereby the both nominator and the nominee will be interviewed together.

In order not to overlook other great individuals who have left a lasting influence on our field, we have added a section to the website focusing on a special group of colleagues called "Storytellers" (www.isakos.com/Archives/Storytellers). These individuals must have left a lasting influence or given invaluable contributions to our field as a leader, researcher, surgeon, colleague, friend, or world-class person. The committee has suggested that "Storytellers" should be present at every ISAKOS conference. Individuals who have been suggested for inclusion in this group include Lanny Johnson, David Dandy, Giancarlo Puddu, Jimmy Andrews, Villarubias, Robert Johnson, and Bernie Einwohner, among others. There is a risk that we will include people belonging to a couple of groups, but we will handle this as we go along.

Landmark Articles in Our Field

The editor of *JISAKOS*, Niek van Dijk, has asked the Committee to look for true landmark articles in our field. Dr. van Dijk or the Committee will choose someone to analyze the value of these articles and to provide commentary on what each article has meant to our field. This content will then be published in *JISAKOS*. Committee members have been asked to identify one "classic" article and send it to the ISAKOS Office. As an example, R. Jakob has identified an article from 1959 by Kenneth Priddy on the most frequently utilized cartilage repair technique in English football players and has volunteered to write the accompanying commentary.

Operative Techniques

Roland Jakob has taught us that trends in orthopaedic techniques tend to move in 25 to 30-year cycles–i.e., that history repeats itself. As such, a lecture entitled "Operative Technique Cycles in History", highlighting the "ups and downs" of such cycles over time, will be presented in Cape Town 2021. Examples of techniques that could be highlighted in the "cycles" symposium include knee osteotomy; the evolution of postoperative management, rehabilitation, and return to sports following ACL surgery; and meniscal repair, among others.

Descriptions of important historical operative techniques described in "classic" articles or books should be identified and added to ISAKOS Archives. Perhaps these descriptions should also be republished in the *JISAKOS* along with commentaries by one or more experts (e.g., "Review of article by Jones on X technique (1963)," with commentary by Maffulli and Olivieri).

Examples of such articles could include Ernest Hey-Groves' article in full, Feagin, Curls ACL augmentation article 1976, Dandy´s article of the first arthroscopic ACL 1981, the first intra-articular ACL reconstruction in Australia in the 1960s, N. Davarinos (2013/2014) "History of ACL," etc.

Articles on osteotomy have been discussed at some length; at least six osteotomy sessions were held at the 2019 ISAKOS Congress, and a number will be included in the 2021 program. Interesting techniques are coming back again, as noted above. The resurfacing of techniques will hopefully attract younger surgeons, all while relating the Archives committee activity to today's time. John Bartlett has told us about the reverse shoulder arthroplasty (Kessler) in the 1970s. A plan will be discussed on how these topics should be presented at the upcoming Congresses.

Rehabilitation and Return to Sport

An important and increasingly popular topic is postoperative management, rehabilitation, and return to sport following ACL reconstruction. The Committee is looking for studies describing major innovations and ideas related to this subject (e.g., Häggmark, Eriksson: Early motion in AJSM from 1978). Barry Tietjens and Per Renstrom are currently taking the lead in identifying and reviewing articles in this area.

A symposium entitled "Healing After ACL Reconstruction Including Rehabilitation and Return to Sport" will be held Cape Town in 2021. Participants will include Darren de Sa, Braden Fleming, and Rachel Fran, with Per Renström as chair. Sue Reimbold encouraged female participation in the program and suggested working with the Gender Diversity Task Force.

Recent Awards

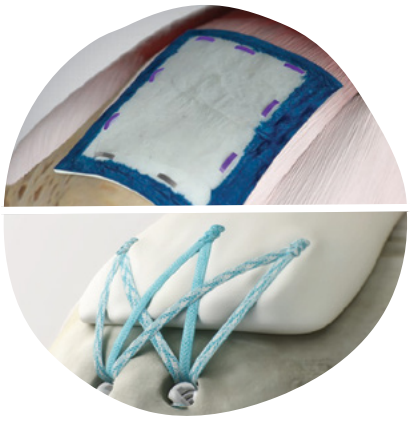
ISAKOS would like to extend congratulations to Dr. John Bartlett, ISAKOS Honorary member and member of the ISAKOS Archives Committee, who has been awarded the Order of Australia for 2020 "for significant service to orthopaedic medicine, and to national and international medical associations." He will now be known as "Sir John Bartlett." ISAKOS would also like to congratulate Honorary member and former president of ISAKOS, Peter Fowler from Canada, who was awarded the Order of Canada in 2018. Peter is now known as "Sir Peter Fowler." These gentlemen have made large contributions to our field and to ISAKOS. We proudly thank them and congratulate them on their well-deserved, high honors.

Final Thoughts

The ISAKOS Archives Committee is off to a good start thanks to the valuable knowledge, experience, and commitment of its members. We all look forward to continuing our work on the many different aspects of ISAKOS history.

Respectfully submitted for the ISAKOS Archives Committee

Advanced healing solutions



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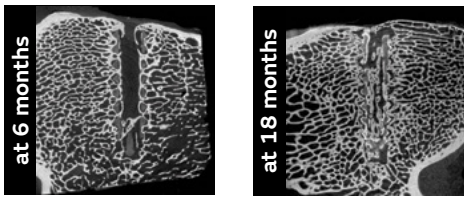
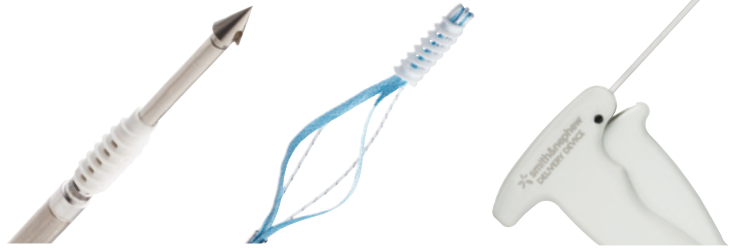


Comparisons of absorption, measured via µCT, at 6 and 18 months.[3]



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Suture Anchor

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References **1.** Data on file at Smith+Nephew, report 15000897, 2012. **2.** Supports HEALICOIL REGENESORB Suture Anchor and HEALICOIL KNOTLESS Suture Anchor. **3.** Data on file at Smith+Nephew, report NCS248 (18 month interim report), 2014.

*In vivo animal testing. Data based on micro CT.

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