ISAKOS

ISAKOS NEWSLETTER 2021 • VOLUME I

Current Concepts on Arthroscopy, Knee Surgery & Orthopaedic Sports Medicine

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

INSIDE

in this issue

International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine

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OFFICE MESSAGE

2021 has **finally arrived**

after the entire world was turned on end due to the pandemic that began in early 2020. Thanks to strong board leadership, focused committees, and a flexible and proactive office staff, ISAKOS has successfully weathered the storm, and in many ways the society has come out of 2020 in better shape and more prepared than ever to help our members face the challenges of the future. Despite the isolation brought on by COVID-19, ISAKOS members have shared that, in 2020, they felt more connected than ever with ISAKOS.

Partial credit goes to ISAKOS's use of Zoom video teleconferencing for 12 webinars and nearly 60 committee meetings in 2020. This breakthrough technology, combined with YouTube, allowed us to reach 7,500 participants through ISAKOS Webinars over the last year—and many more who visited Global Link to watch recordings. A brand new initiative for 2020, ISAKOS Webinars were made possible through the exceptional foresight of the Education Committee, the skillful planning of many ISAKOS clinical committees, and the impressive juggling and execution abilities of the ISAKOS staff. We also expanded ISAKOS's collaboration with multiple partner societies on a number of webinars, some of which featured a trial of translation into Spanish, Portuguese, and Mandarin. These webinar collaborations, which extend ISAKOS's reach around the world, have continued with four new webinars already in 2021 and more to come.

Another way in which we have made it easier for ISAKOS members to stay connected is through the full member directory that is featured in the newly launched ISAKOS App, which is now available for download in the App Store and Google Play store. With this app, you can easily access all of your favorite ISAKOS resources right in the palm of your hand. *Journal of ISAKOS* articles and ISAKOS books are only one touch away. You can view the 2021 ISAKOS Congress interactive agenda with the touch of a button. You can also watch the latest Global Link videos on-the-go, right on your mobile device. All of this and more is waiting for you when you download the new ISAKOS App.

ISAKOS also ensures members' ability to stay up-to-date on the latest literature by offering a fresh approach to *JISAKOS* Podcasts, while a new series of ISAKOS Podcasts shares the latest news and perspectives from the society. A new ISAKOS Thought Leaders Blog was launched as well, giving voice to thought leaders from across the organization on topics ranging from the contributions of young professionals to the challenges and opportunities facing women who pursue medical careers in orthopaedic sports medicine. We also created the "Giants in Orthopaedic Sports Medicine" series of video interviews, highlighting the contributions of living legends who have helped to make ISAKOS the excellent organization that it is today.

So how will we keep you connected in the coming year? We'll continue to deliver all of these new member benefits while also connecting you with exceptional content through a collection of microlearning videos on Global Link, new virtual and in-person courses on topics ranging from robotics to surgical skills training, and the production of 10+ new ISAKOS books that are already in the works. To cap off the year, you will be able to connect with your colleagues by attending the ISAKOS Congress in November.

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We look forward to helping you **stay connected with ISAKOS in 2021!**

The COVID-19 Pandemic

Lots has changed and some things haven't! Some will stay, and some won't!

The COVID-19 global pandemic has led to many changes in the orthopaedic care of our patients and also our academic lives. In our practices, we have been paying much more attention to healthy habits, including handwashing and staying home when ill. We are also cleaning surfaces carefully and paying more attention to supply chains for medical equipment, in particular, personal protective equipment. The rapid development of safe vaccines has also been unprecedented.

Our education via virtual meetings has suddenly improved access for many. While we look forward to traveling without so many precautions, it has become clear that a lot of our meetings can be held via videoconference to accomplish the goals. It is likely that video conferencing will become a bigger part of our lives in a post COVID-19 world than it was before.

Many things have not changed. The need for continued health care research and advancement has been highlighted recently. The surge in orthopaedic manuscript submissions to our peer-reviewed journals illustrates that even amidst very challenging times, our community continues to strive to advance the science upon which our patient care is based. As well, the commitment and self-sacrifice many healthcare professionals made to save the lives of others, including many of my colleagues at our hospital, has been inspiring. The desire to gather with friends and family is now stronger than ever, and I will never take for granted these opportunities in the future. Gathering with colleagues to connect, learn, teach and build relationships via live meetings is something we all look forward to. The next ISAKOS Congress in Cape Town in November 2021 will provide a great opportunity for that!

Lastly, the ISAKOS Office has adjusted and pivoted to continue to serve our members during these difficult times. They have transitioned to work remotely and have made many changes to their workflow in order to keep costs down while still providing great leadership for our society. That is something that has definitely not changed during these challenging times!

Robert G. Marx, MD

ISAKOS Newsletter Editor 2019–2021

JOURNAL OF
ISAKOS
Joint Disorders & Orthopaedic Sports Medicine

The New Year period is a time of reflection and well wishes. The past year has been one that we want to forget but never will. Each day, we are faced with new changes that impact our daily life. For me personally, it was always "family first," but the past year has made us even closer as a family.

The past year has reconfirmed the power and importance of science, with the quick reaction by and collaboration among scientists all over the world that resulted in a reliable vaccine within 9 months after the publication of the COVID-19 genetic sequence. In spite of the development of these vaccines, it remains challenging to project ourselves in the future. We all wish to return to normal. We have learned to communicate online in Zoom meetings and webinars, but we miss the interaction between humans. Let's be confident that we will all meet for the ISAKOS conference in Cape Town in November, 2021.

In spite of COVID, 2020 was an excellent year for *JISAKOS*. The number of submissions increased by some 75%, with an overall rejection rate of >50% and an acceptance rate for original research of 40%. These figures are important for the Index Medicus application. We applied for Medline indexing last November and expect to receive an answer in the early spring.

Also in 2020, we expanded our Editorial Board and appointed some key editorial positions, including Elizabeth Arendt as Deputy Editor. Liza is Vice Chair of the Department of Orthopedic Surgery of the University of Minnesota. She is a highly respected ISAKOS member and is well respected in the worldwide orthopaedic community. I am personally very happy that she will support *JISAKOS* in this important position. In addition, Emily Leary was appointed as our statistical editor. Emily is Director of Orthopedic Biostatistics in the Department of Orthopaedic Surgery of the University of Missouri. She will provide in-depth reviews of manuscripts whose statistical methods and analysis need attention. Our two social media editors, Manos Brilakis and Andreas Voss, have been very active and will continue to post tweets every other day and coordinate the podcasts for *JISAKOS*. A major focus in 2021 is to gain a larger audience; to that end, our offerings will include live interviews that add expert opinions and comments on controversial methods and techniques.

Also new in 2021 will be a video-based section on surgical techniques, with Kevin Parvaresh from the medical group of Orange County serving as section editor. We are currently finishing the guidelines for authors, and Kevin will prepare two example videos to serve as a reference for submissions.

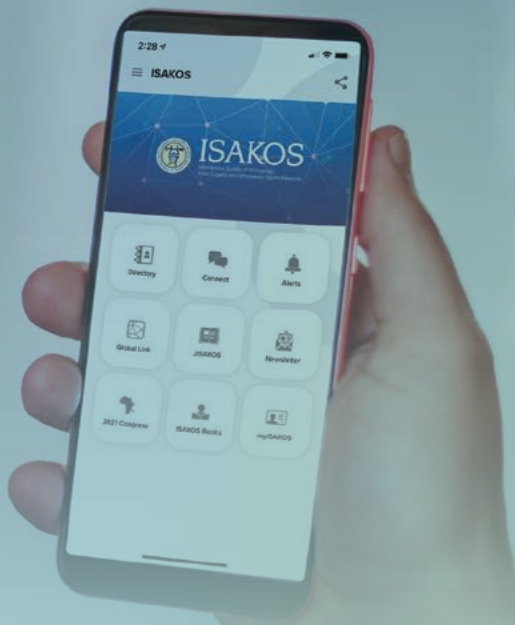
Overall, 2021 will be an important year in which we will need to make the important decision as to whether *JISAKOS* will become an Open Access (OA) journal. We also have celebrated the 25th anniversary of ISAKOS and the 5th anniversary of *JISAKOS*. To this end, we will acknowledge the best papers with a $1,000 prize at the 13th biennial ISAKOS conference in Cape Town.

Finally, I would like to take the opportunity to thank all of those who helped to make *JISAKOS* to what it is today: the Board of Directors, Sue Reimbold and her dedicated crew from the ISAKOS Office, the members of the editorial board (JIBOT), our publisher (BMJ), our consultant Stephan Welch, our managing editor Leendert Blankevoort, the authors who submitted their manuscripts, and, especially, our reviewers. We understand that our reviewers may have longer hours and extra responsibilities that come before *JISAKOS*, especially during these challenging times. For that reason, we are even more grateful for their efforts, and it is because of their fantastic work that our journal is flying. A big thank you for all of your contributions.

I wish for you all to be well and to remain healthy.

C. Niek van Dijk, MD, PhD
NETHERLANDS

Editor in Chief, *JISAKOS*
c.niekvandijk@jisakos.com



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ISAKOS Newsletter Current Concepts Submission Guidelines

The ISAKOS Newsletter will consider articles that are clinically relevant, pearls and pitfalls, etc., but will not publish original clinical research.

Please visit jisakos.bmj.com to submit original research to the *Journal of ISAKOS*.

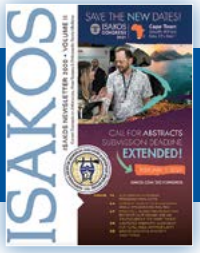
The ISAKOS Newsletter is published twice a year, in March and September.

March – Volume I
Content must be received by **December 1**

September – Volume II
Content must be received by **June 1**

Style Guidelines:

- 1,000–2,500 Words, and submitted in an editable format (Microsoft Word preferred)
- 3–5 Figures - Figures must be high resolution
- Maximum of 5 references
- Articles must include author information, including;
  - Full name, degree(s) and country
  - University or hospital affiliation
  - Color headshot for each author



Explore our ISAKOS Newsletter archive at **isakos.com/GlobalLink/Newsletter** for examples of submitted Current Concepts!

Important Notes Regarding Newsletter Submissions:

- **Committee approval:** Each article submission must have the approval of an ISAKOS Committee.
- **ISAKOS member authors:** The primary author must be an ISAKOS member. If there are multiple authors, at least one author must be an ISAKOS member, including the primary author.
- **Submission policy:** Each Committee Chair or Member may only author/co-author one article every 2 years. There must be a break period of 4 issues between publishing.
- All articles are reviewed by the Newsletter Editor and Copy Editor.
- Article inclusion in not guaranteed and is at the discretion of the Newsletter Editor and ISAKOS Office.
- You will be notified via email if your article has been accepted, declined, needs further editing, or is held for a future issue.

If you have any questions, please contact the ISAKOS Office at newsletter@isakos.com

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CONGRESS
2021
Cape Town
South Africa
Nov 27 – Dec 1
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#ISAKOS2021

Dear ISAKOS Members, Colleagues, and Friends,

We hope that this update finds you well and safe after a very trying year marked by the many challenges brought about by the COVID-19 pandemic. We thank you for your continued support, and we extend our sincere gratitude to the many dedicated faculty members who have been hard at work planning for the 2021 ISAKOS Congress! As we continue to look forward to meeting face-to-face once again, we would like to share the following update.

The ISAKOS Congress continues to be planned as an in-person meeting to be held live in Cape Town, South Africa. The Congress provides a variety of new preventative, therapeutic, and surgical technique information, allowing participants who attend this meeting in Cape Town to expand their knowledge and enhance their surgical skills. This four-day meeting at the Cape Town International Convention Centre will include a variety of educational opportunities from Sunday through Wednesday, such as surgical demonstrations, paper presentations, debates, global case-based discussions, roundtable panel discussions, lectures, symposia, and instructional course lectures. Lunchtime sessions, e-posters, technical exhibits, and social activities will also be offered to Congress attendees who join ISAKOS for this live meeting. Plus, a 2.5-day Sports Rehabilitation Concurrent Course will be offered starting Saturday afternoon, November 27.

While we fully expect that the meeting will proceed live in Cape Town, we understand that, with the ongoing pandemic uncertainty, possible new developments in 2021 could render attending an in-person meeting difficult. Please know that the ISAKOS Congress will definitely be going ahead in November 2021, in whatever format necessary, and therefore, you should feel comfortable planning your submissions, your faculty commitment, and your attendance, in whatever format you are able to do so.

With these thoughts in mind, we are very hopeful that we will again be able to share the unique global experience that is provided by the ISAKOS Congress. For now, here are just a few of the 2021 Congress highlights that we are excited to offer. Please plan to join us!

Volker Musahl, MD, UNITED STATES,
2019-2021 ISAKOS Program Committee Chair

Mark Clatworthy, FRACS, NEW ZEALAND,
2019-2021 ISAKOS Program Committee Deputy Chair

Joy Allen-Joseph
ISAKOS Director of Education & Engagement

ISAKOS 25th Anniversary Symposium: The Road to Create ISAKOS,

presentations by David James Dandy, MD, FRCS, UNITED KINGDOM; Peter J. Fowler, MD, FRCSC, CANADA; Roland P. Jakob, Professor Emeritus, SWITZERLAND; Gary G. Poehling, MD, UNITED STATES

ACL Career Highlights Symposium with Freddie H. Fu, MD, University of Pittsburgh,

moderated by Marc R. Safran, MD, UNITED STATES, and Willem M. van der Merwe, MBChB, FCS(SA)Ortho, SOUTH AFRICA

History and Legends Symposium

with Co-Chair Peter J. Fowler, MD, FRCSC CANADA; Co-Chair Per A. Renström, MD, PhD, SWEDEN; John Bartlett, AM, MB, BS, FRACS, FAOA, AUSTRALIA; John A. Bergfeld, MD, UNITED STATES; Masahiro Kurosaka, MD, JAPAN; Lars Peterson, MD, PhD, SWEDEN; Savio L-Y. Woo, PhD, DSc, Deng, UNITED STATES

How to get Published in the Journal of ISAKOS Symposium, with Editor's Tips for Maximizing Your Journal Submissions.

Presentations will include How to Improve Your Manuscript, The Perfect Case Report, How to Improve Surgical Technique Videos, and the JISAKOS Awards for Best Articles. Chair, C. Niek van Dijk, MD, PhD, NETHERLANDS; Freddie H. Fu, MD UNITED STATES; Kevin Parvaresh, MD, UNITED STATES

ISAKOS Research Symposium, based on the popular ISAKOS & ESSKA book entitled *Basic Methods Handbook for Clinical Orthopaedic Research*, ©2019.

Editors: Volker Musahl, Jon Karlsson, Michael Hirschmann, Olufemi Ayeni, Robert Marx, Jason Koh, Norimasa Nakamura. This publication provides essential knowledge on all aspects of research methodology in orthopaedics; presents a series of typical case examples for common research approaches and study types; and aids researchers at all levels of experience in the performance, presentation, and reporting of studies.

6
"Meet the Experts" Global Case-Based Discussion Sessions
with ISAKOS experts on the topics of knee arthroplasty, knee ligaments, massive shoulder rotator cuff, shoulder instability, gender and diversity, and working through COVID-19.

10+
Knee Arthroplasty Sessions
with international faculty offering a global perspective on the very latest in knee arthroplasty.

20+
Surgical Demonstrations by ISAKOS legends.

36
Instructional Course Lectures (9 each day of the Congress).

ISAKOS Awards Ceremony celebrating the winners and finalists of **8** ISAKOS Scientific Awards.

Best of the Best
Podium and e-Poster presentations

Plus, more **debates**, more global case-based **discussions**, and more roundtable **panel discussion sessions** with global faculty offering their perspectives on the **very latest research** in orthopaedics.

It is with optimism for a brighter future that we ask for your continued support and planned attendance at our 13th Biennial ISAKOS Congress, November 27 to December 1, 2021.

We are committed to providing you with the highest-quality program and events that an ISAKOS Congress can offer. The 2021 Congress website will continue to be updated with pertinent and current information as the year unfolds.

We appreciate your continued support of ISAKOS, and we look forward to welcoming you to the 2021 ISAKOS Congress in Cape Town, South Africa, this November.

Wishing you and your families good health in 2021.

2021 ISAKOS by the Numbers

Congress

2021 ISAKOS Congress in Cape Town, South Africa

428 **Faculty & Presenters** from **50+ Countries**

36 Instructional Course **Lectures**

23 Surgical **Demonstrations**

10 **Debates**

1,600+ Abstracts **Submitted**

15 Global Case-based **Discussions**

2 Round Table **Discussions**

41 **Symposia**

ISAKOS Publications

Journal of ISAKOS

6 Issues in 2020 including:

48 Papers **Published**

224 Unique **Authors**

79 Unique **Reviewers**

ISAKOS Biannual Newsletter

2 Issues **in 2020**

11 Current **Concepts**

2,500+ Print **Subscribers**

18,750+ Digital **Views**

ISAKOS Books

25 Books and Booklets **Published to Date**

10+ New Books in **Production for 2021**

Society

ISAKOS Membership

Over 90%
Member **Retention**

Members in
98
Countries

3,000+
Members
Worldwide

ISAKOS Committees

489
Committee
Members

29
Total
Committees

58
Meetings
Held in 2020

ISAKOS Education

ISAKOS Webinars

12
Webinars
in 2020

10+
Webinars Planned
for 2021

20,000
Registrations

Participants from
133
Countries

ISAKOS Global Link

53
Surgical
Videos

12
Webinar
Recordings

10+
Micro-Learning
Videos

1,000+
Media Items
from 2019 Congress

Research Grants

10+
Total Grants
Given

4
Research Grant
Categories

$175k
Funding per
Grant Cycle

Awards, Fellowships, & Scholarships

13
Award & Fellowship
Opportunities

100+
Award & Fellowship
Applicants

International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine

Thank you for helping ISAKOS continue to provide excellence in research and education.

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Preparing the Soil: Targeting Meta-Inflammation in Musculoskeletal Regenerative Medicine

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Introduction

It is well known that the rise in metabolic syndrome (MS) has become a major health burden across the globe. Excessive caloric intake and poor dietary habits pave the way for the progression of "meta-inflammation," which disrupts metabolic equilibrium and eventually aggravates low-grade chronic inflammation throughout the body[1].

By definition, meta-inflammation is a state of chronic inflammation mediated by macrophages that are present in certain locations such as the liver, muscle, adipose tissue, pancreas, colon, and brain[2]. These cells are known to coordinate immune activity and homeostasis, taking on different roles and displaying many cellular properties, depending on time and various biochemical stimuli[2]. Meta-inflammation can disrupt proper cell signaling and macrophage polarization, a process that also appears to be linked to MS. While meta-inflammation and disrupted cell signaling have been associated with MS and other autoimmune disorders, other unknowns still remain to be explored with regard to the origins and initiatory mechanisms of this disorder. In any case, this disorder still poses a great challenge for orthopaedic surgeons and other medical practitioners as chronic inflammation has been shown to harm musculoskeletal structures[1]. Musculoskeletal complications may be treated with conservative alternatives as well as novel therapeutic interventions such as the application of orthobiologics, which are regenerative therapies that are used to facilitate the healing of variety of tissues. Popular examples include hyaluronic acid, platelet-rich plasma, bone marrow, adipose tissue, and expanded mesenchymal stem cells[3]. In order to promote a more effective response, however, medical professionals must "prepare the soil" before managing a patient with an orthobiologic intervention. In other words, the target tissue must be biologically receptive to therapeutic agents. This goal can be achieved by designing health protocols that modulate an individual's metabolic profile with the inclusion of dietary modifications, intermittent fasting, health supplements (minerals and vitamins), hormonal regulation, and other alternatives.

The objective of this review is to discuss some but not all of the known biologic soil-preparation alternatives in the fight against meta-inflammation, demonstrating the importance of primarily addressing low-grade chronic inflammation preceding interventional therapies.

Macrophage Polarization

The polarization of macrophages has been broadly divided into two distinct phenotypes (M1 and M2), which are attributed to the corresponding Th1 and Th2 (t helper) cell responses[4]. The M1 macrophages have been classically associated with inflammatory responses. These responses are usually mediated by certain inflammatory agents such as interferon-γ (IFN-γ) and lipopolysaccharide (LPS), which allows these cells to develop microbicidal and proinflammatory properties, a main feature of this specific phenotype. M1 receptors for cytokines and LPS, in turn, allow signal transduction, which results in the expression of well-known inflammatory mediators such as inducible nitric oxide synthase (iNOS), tumor necrosis factor-α (TNF-α), and chemokine (C-C motif) ligand 2 (CCL2/MCP-1)[4].

Although these cells are important because they are the first line of defense against infectious agents, they can cause significant harm to proximal immune and parenchymal cells through the generation of microbicidal agents, including reactive oxygen species (ROS) and proteases, for instance, as well as continuous stimulation of other leukocytes[4]. Conversely, the M2 subtype has been well-linked to Th2 lymphocyte responses, displaying hyporeactivity to the aforementioned M1-type ligands, thus being considered anti-inflammatory. The M2 phenotype switch takes place at later stages, following the induction of the M1 response. This biological event usually occurs after the engulfment of apoptotic neutrophils in addition to other signals. This stimulates macrophages to downregulate their own pro-inflammatory roles and shift their properties toward the resolution phase of the inflammatory cascade and, ultimately, tissue repair[4].

Conceptualization of Meta-Inflammation

Irregular macrophage polarization can contribute to obesity-induced insulin resistance (IR), one of the well characterized clusters for MS and meta-inflammation. For instance, the macrophages localized in the adipose tissue of lean individuals are generally shifted toward the M2 phenotype, being predominantly anti-inflammatory in nature[2]. The inflammatory stress caused by obesity results in the recruitment of pro-inflammatory M1-like macrophages into the adipose tissue. In fact, possible contributions of pro-inflammatory macrophages to obesity-associated inflammation and IR have been proposed. As an example, macrophages residing in adipose tissue dampen the insulin response in adipocytes during obesity and augment inflammatory reactions via the dysregulated production of more pro-inflammatory cytokines[2]. To make matters worse, obesity-induced metabolic stress not only allows the infiltration of M1 macrophages but also causes the M2 macrophages to switch back to their former role[2].

These circumstances are particularly detrimental to certain organs and tissues, especially those of a musculoskeletal nature. To illustrate, a very recent study[1] investigated the association between chronic low-grade inflammation (metabolic syndrome) and the harmful subchondral bone alterations during the onset of osteoarthritis (OA). The authors reported that large molecules may traverse between both bone and cartilage compartments in both healthy and diseased joints. This opens up the possibility for dysregulated circulatory "inflammokines" (inflammatory cytokines) to infiltrate the joint compartment and interfere with regular cell signaling and metabolic activity, causing inflammatory stress. Unresolved cellular stress fragilizes osteochondral integrity, causing the loss of demarcation between bone and articular cartilage, exposing the subchondral bone and its nerves to imbalanced biochemical and biomechanical signals.

Continuous stress promotes additional tissue alterations, establishing a positive feedback loop as a result of multiple unsuccessful attempts to return to cell homeostasis.

Taking the aforementioned facts into consideration, it is important for medical practitioners to prepare the soil, designing interventional strategies to halt inflammation and reestablish tissue homeostasis. This can be achieved by a combination of conservative approaches preceding orthobiologic treatments, as presented in the following section.

Preparing the Soil

In order to reverse a patient's state of chronic inflammation and prepare the soil, doctors must thoroughly analyze the individual's health style and apply suitable modifications, especially dietary habits.

Sleep Quality

Often overlooked, sleep quality is an important key factor that must be put in check in order to improve health. Mediators of inflammation can be significantly altered by loss of sleep. The circadian rhythm is, in great part, responsible for a wide variety of functions such as cellular division, migration, metabolism, and other biological processes. The physiological alterations that take place during sleep are believed to promote a favorable microenvironment for stem cells to proliferate, migrate, and differentiate. Such biological events strongly rely on circadian clock genes or other variables, including growth factors, cytokines, and hormones. Melatonin and cortisol, in particular, are released in response to neural optic signals and work cooperatively to regulate many biological functions during sleep. Melatonin appears to enhance osteogenesis and chondrogenesis while inhibiting adipogenesis. Additionally, it may also be protective against oxidative stress-induced apoptosis in mesenchymal stem cells (MSCs), dampening intracellular reactive oxygen species (ROS) production to improve cell viability and secure MSC differentiation into other lineages. With regard to musculoskeletal tissue health, melatonin appears to be highly beneficial because of its capacity to enhance bone alkaline phosphatase levels and mineralization, promote the synthesis of type-I collagen, and increase bone mass and growth. Furthermore, it also may counteract the reduction of cell proliferation by iron overload in bone marrow-derived MSCs upon reversion of the upregulation of p53, ERK, and p38 protein expression in cells.

Hormone Screening

The assessment of specific hormones is another important strategy. Thyroid hormones, for example, are known to have vital roles that influence the biochemical content of cells, such as the enhancement of collagen production in chondrocytes, for instance. Testosterone is another hormone with indispensable functions.

Preparing the Soil: Targeting Meta-Inflammation in Musculoskeletal Regenerative Medicine

Its anabolic effects on bone cartilage have been well described for decades. Its ability to regulate the maintenance and recovery of muscle mass may have a direct impact on the outcomes of various therapies. To elaborate, low testosterone levels in both men and women lead to an increase in muscle catabolism and an increase in body fat deposition.

Testosterone stimulation increases the proliferation and preservation of stemness of MSCs and endothelial progenitor cells (EPCs), which indicates that, in addition to other factors, this anabolic steroid hormone may guide these cells and increase their therapeutic potential. Similarly, dehydroepiandrosterone (DHEA) appears to antagonize catabolic mediators of cartilage and may display protective effects in OA, including the inhibition of matrix metalloproteinases (MMPs) while favoring cartilage restoration. Actually, DHEA's positive effects on OA may be attributed to its ability to influence the balance between the aggrecanases and tissue inhibitors of metalloproteinase-3 (TIMP-3) in chondral tissues, suggesting a suitable role in protecting articular cartilage from degeneration at the molecular level. Estrogens should not be dismissed, either. The absence or insufficient concentration of this hormone causes elevated bone resorption, thereby allowing the establishment of osteoporosis-like phenotype and aggravation of microscopic OA features that develop in both sexes.

Dietary Modifications

Perhaps one of the most obvious and least expensive strategies to fight meta-inflammation is to place the patient on a specific dietary regimen. Adequate diet is extremely important for bone and cartilage health, particularly when it comes to the comparison of fat and carbohydrate content in specific meal plans. For instance, bone formation appears to be increased in high-fat diets as a result of osteoblast activity, at least in rats. Conversely, high concentrations of sugar in specific diets may promote bone marrow adipose expansion and the subsequent alteration of the bone marrow microenvironment. This is also accompanied by the shift toward a more pro-inflammatory microenvironment, which could have additional detrimental effects on bone metabolism and musculoskeletal health.

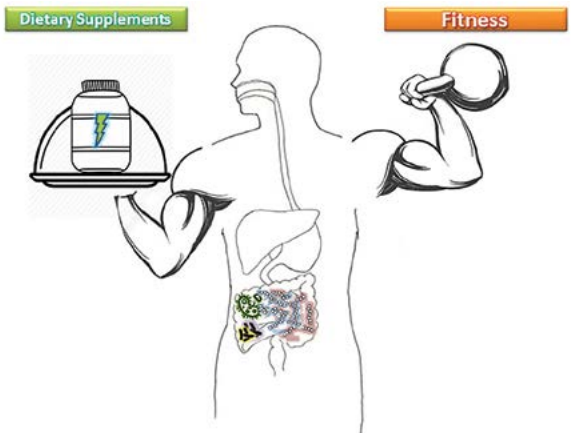
Further expanding on carbohydrates, fructose consumption also can reduce the osteogenic potential of stromal cells in the bone marrow and can increase the adipogenic differentiation tendency, which is particularly harmful to the bone microarchitecture.

MS-derived inflammation is strongly associated with a higher prevalence of symptomatic knee OA as well as with higher serum interleukin (IL)-6 and tumor necrosis factor (TNF)-R2 levels, suggesting that there is a close relationship between diet and inflammatory parameters that culminates in the progression of OA.

A viable solution for this problem is the inclusion of the anti-inflammatory Mediterranean diet, which is known for its positive effects in the management of symptoms. Individuals who adhere to this dietary habit may exhibit far less prevalence of knee OA in comparison to those who do not. The Mediterranean-style diet is an established healthy-eating diet pattern that seems to convey beneficial effects on metabolic, cardiovascular, musculoskeletal, and cognitive diseases. It also may be partially responsible for a reduction in oxidative stress markers and the promotion of elevated levels of type-II collagen and aggrecan expression, while inhibiting apoptosis-related protein synthesis.

Gut Health

The intestinal flora are known to be a key regulator of bone health, affecting postnatal skeletal development and skeletal involution, for instance. Alterations in bacterial populations and host responses to the gut microbiome may collectively contribute to negative reactions resulting in bone loss. The positive alterations in microbiota composition that help to prevent and even reverse bone loss can be generated via the incorporation of nutritional supplements into a diet plan, especially those that are enriched with prebiotics and probiotics (Fig. 1). By definition, probiotics are viable microorganisms that confer health benefits when administered in adequate quantities. Prebiotics, in turn, are non-digestible fermentable food ingredients that stimulate the growth of benevolent microbes and promote beneficial changes in the gut microbiome behavior. This is a particularly important strategy as the gut microbiome regulates bone mineral density.



01 Nutritional supplementation with prebiotics and probiotics that increase the biosynthesis of SCFA production in combination with the regular practice of physical activity may represent an effective, safe, and inexpensive alternative for the improvement of musculoskeletal regenerative medicine.

Furthermore, the short-chain fatty acids (SCFAs) that are produced by the fermentation of complex carbohydrates and dietary fibers by the gut microbiota appear to be pivotal regulatory metabolites. These metabolites can halt the recruitment and activation of macrophages and other white blood cells by reducing the synthesis of pro-inflammatory cytokines. SCFAs also may act on T-regulatory cells, leading them to suppress osteoclast differentiation via the secretion of anti-osteoclastic cytokines. Interestingly, gut-derived lipopolysaccharides are able to provoke generalized pro-inflammatory responses in their hosts as well as increased accumulation of adipose tissue-resident macrophages, shifting the polarization of alternatively activated M2 macrophages toward their pro-inflammatory M1 counterpart. Physical activity, however, may modulate the gut microbiome composition (especially Lactobacillus and Bifidobacterium species), enhancing mucosal immunity (Fig. 1). Proper fitness can enhance mucosal immunity by reducing detrimental LPS effects via the suppression of TLR signaling, increasing the Bacteroidetes-Firmicutes ratio, modifying the bile acid profile, and ameliorating the biosynthesis of SCFAs.

Conclusion

In this manuscript, we briefly review and discuss the impacts of metabolic inflammation on health. The state of chronic low-grade inflammation (metabolic syndrome) is significantly mediated by increased pro-inflammatory macrophage activity, causing harm to various tissues, especially those of a musculoskeletal nature. Preparing the soil is an essential component of regenerative medicine as it allows medical experts to control the inflammatory status of a patient and prepare eligible anatomical structures for corresponding orthobiologic treatments. The strategies presented in this manuscript may prove to be effective, safe, and inexpensive modalities targeting meta-inflammation.

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The Eeklo Subvastus Approach for Total Knee Arthroplasty Detailed Surgical Technique

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Introduction

This technical note describes a medial subvastus approach, the Eeklo medial subvastus (EMS approach), which is characterized by multiple shifted layers (comparable with the lateral Keblish approach) and preservation of the soft-tissue envelope. The approach was developed by one of the authors (G.I.), and both authors have used this technique for both primary and revision total knee arthroplasty (TKA) for >10 years.

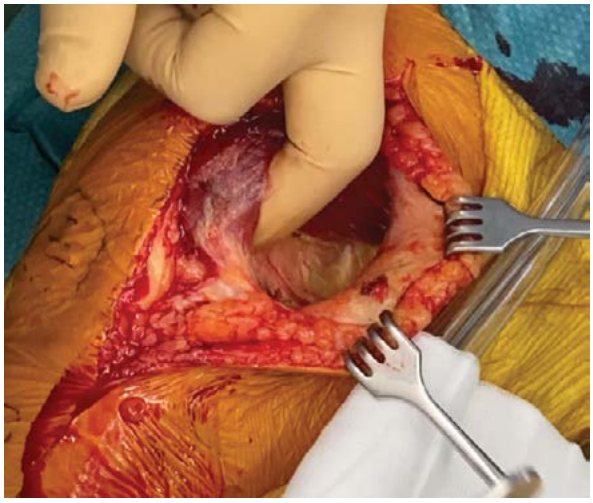
This approach has a number of advantages. First, the medial incision preserves the blood supply to the patella, lowering the risk of patellar fractures or necrosis. Second, the extensor mechanism remains intact, thereby maintaining quadriceps function. Third, the offset of healing scar tissue between different layers secures sealing and coverage of the joint and decreases the risk of stiffness. In addition, we believe that preservation of the soft-tissue envelop plays an important role in ligament balancing as periarticular soft tissue loads after TKA can be restored to those typical of the native knee[1,2]. Accordingly, minimal ligament release is performed. While this reduced exposure may lead to some errors in the positioning of the components in the absence of a learning curve, we believe that the minimal soft-tissue damage significantly reduces postoperative bleeding and pain as the periosteum is very sensitive[3].

Technique

The patient is managed with tranexamanic acid and is placed under general anesthesia, allowing for full muscle relaxation and stable controlled hypotension. Footrests and lateral butresses are utilized to maintain the knee in varying positions from extension to full flexion. No tourniquet is applied.

A longitudinal skin incision is made medial to the midline and is positioned to avoid osseous prominences, beginning proximally 1 cm from the medial border of the patella and extending 1 cm from the medial side of the tibial tubercle with the knee in flexion (Fig. 1). The length of the incision varies and is sufficient to prevent any excessive traction on the skin. The incision typically starts approximately 10 cm proximal to the superior pole of the patella and is carried straight through the subcutaneous tissue to the fascia over the vastus medialis obliquus (VMO) muscle. The fascia is opened, and the underlying muscle fibers are left intact. The muscle fibers are released from the medial intermuscular septum in a proximal direction with use of blunt dissection. A finger can be placed underneath the medial border of the VMO (Fig. 2). Careful hemostasis of the perforating arteries entering the muscle may be required, helping future mobilization.

01 Medially translated incision.



02 Blunt dissection of the posterior border of VMO and coagulation.

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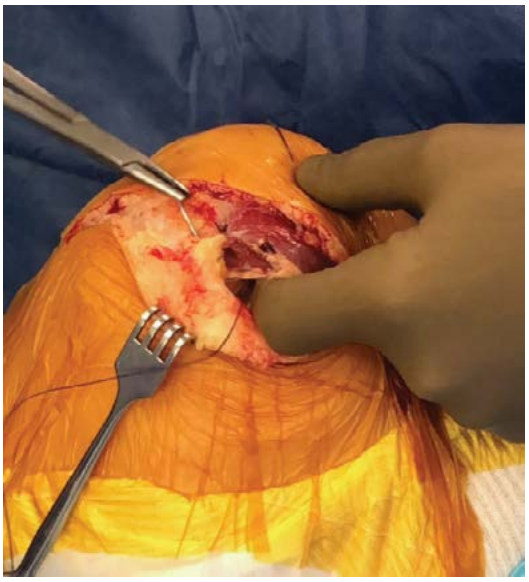
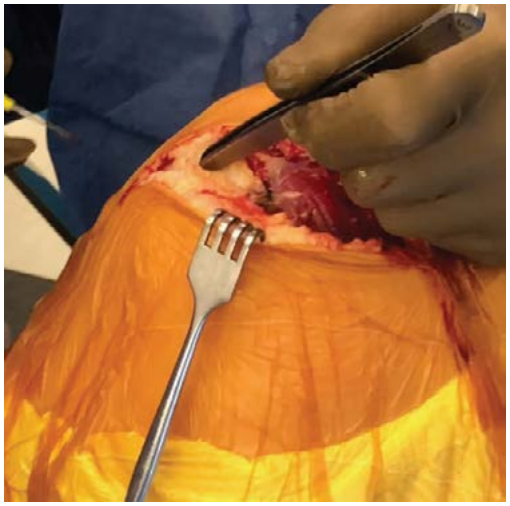
The VMO is lifted to check its distal attachment to the patella, linked to the superior edge of the easily recognizable medial patellofemoral ligament (MPFL) (Fig 3).



03 The superior edge of the MPFL, with 2 stiches as landmarks.

On this edge, two sutures are used to ligate the descending genicular artery and will serve as a reference to reattach the MPFL-quadriceps complex at the closing step of the procedure[4].

A vertical section of the MPFL that remains extrasynovial is left between the sutures. A pair of forceps is passed between the two layers (Fig. 4), either from proximal to distal or, conversely, from distal to proximal, starting where a fat spot appears at the distal border of the MPFL-complex.



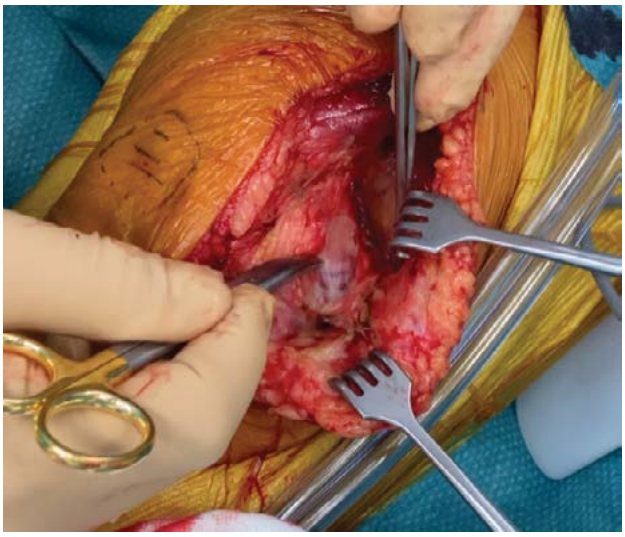
04 A pair of forceps is passed between the MPFL and the synovium.

The cut is extended distally. Blunt forceps are inserted and are slid distally between the retinaculum and the underlying periosteum down to resistance, which is created by the attachment of the pes anserinus. The retinaculum is transected, with care being taken not to damage the subcutaneous fat, which can be gently manually peeled. The medial tissue contains the infrapatellar branch of the saphenous nerve.

The MPFL proximally and the retinaculum distally are pushed backward with a wrap over the intact synovium and periosteum (Fig 5).

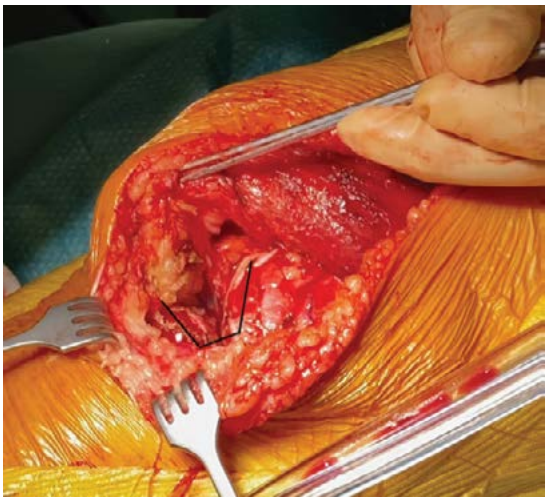
05 The MPFL is pushed posteriorly.

The anterior edge of the medial collateral ligament (MCL) is palpated. Regularly, three veins run parallel to this structure at the superior edge of the synovium. These veins can serve also as a landmark and are coagulated (Fig. 6).



06 Veins in front of the anterior edge of MCL.

The arthrotomy commences with the creation of a square synovial flap (Fig. 7). The posterior limit is vertical, just anterior to the MCL and distal to the medial meniscus. The geniculate artery is coagulated in its wall.



07 Forceps hanging the synovial flap. The lines indicate the margins of the flap.

The inferior margin is made horizontally at the tibial plateau level, just under the medial meniscus, and the superior margin follows the junction bone and trochlear cartilage.

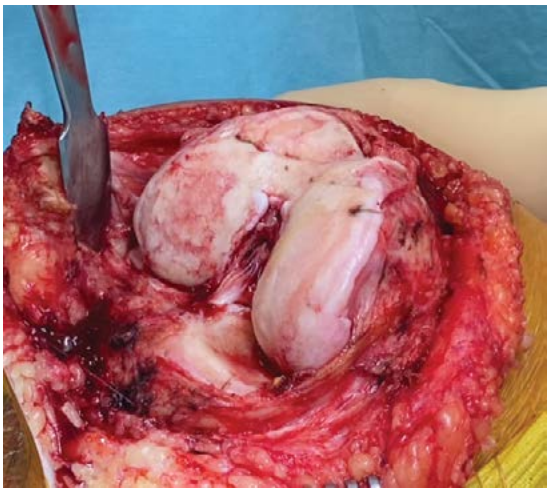
The arthrotomy is extended proximally by retracting laterally on the extensor apparatus with a Hohmann retractor. The synovium of the sub-quadriceps recess is opened until the lateral part of the trochlea is reached without release of the femoral synovium.

The inferior capsulotomy is extended horizontally toward the patellar tendon (PT), with the tibial periosteum being left intact. A Hohmann retractor is positioned in the sliding space between them. Step by step, the anterior horn of the medial meniscus, the anterior synovial fold, and then the anterior third of the lateral meniscus are detached with electrocautery, with the fat pad and lateral periostum being left intact (Fig. 8).

08 Inferior capsular release, with the fat pad and periosteum left intact.

Then, with gentle retration on the PT at its medial distal insertion, the medial patellar tibial ligament (MPTL) is detached till the PT fibers are well individualized.

At this stage, the extensor apparatus is fully free and the patella can be dislocated into the lateral gutter, gliding without eversion (Fig. 9).



09 View of the joint after the patella has been dislocated.

One or two Hohmann retractors are positioned on the lateral edge of the tibia, providing wide exposure of the entire joint.

On occasion, extension of the distal skin incision can help to preserve the underlying subcutaneous fat and thereby avoid damage to the infrapatellar branch of the saphenous nerve.

We try to preserve as much of the soft tissue as possible (including the peripheral rim of menisci and the fat pad), with any release being performed for exposure, irrespective of the type of TKA prosthesis being used (e.g., posterior stabilized, cruciate-retaning, fixed, mobile, hinged, etc.).

Once exposure has been achieved, the appropriate procedure can be performed as usual with use of the knee system preferred by the surgeon.

We perform adrenaline and rovipacaine injections in the periosteum and around the knee for postoperative pain relief, followed by closure in separated planes. The synovial flap is closed first, with its lower part fixed to the tibial periosteum (Fig. 10). Finally, the retinaculum is closed, the MPFL complex is reattached anatomically, and the subcutaneous tissue and skin are closed as usual with the knee in 30° of flexion.

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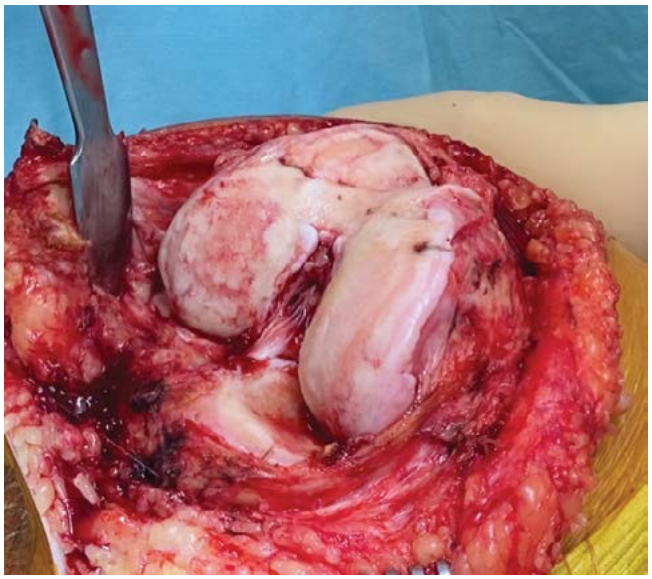

10 First layer of closure, with the synovial flap sutured to the tibial periosteum.

Competing Interests

The authors declare that they have no competing interests with this topic.

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The Osteochondral Lesion: Management Options Now and Going Forward

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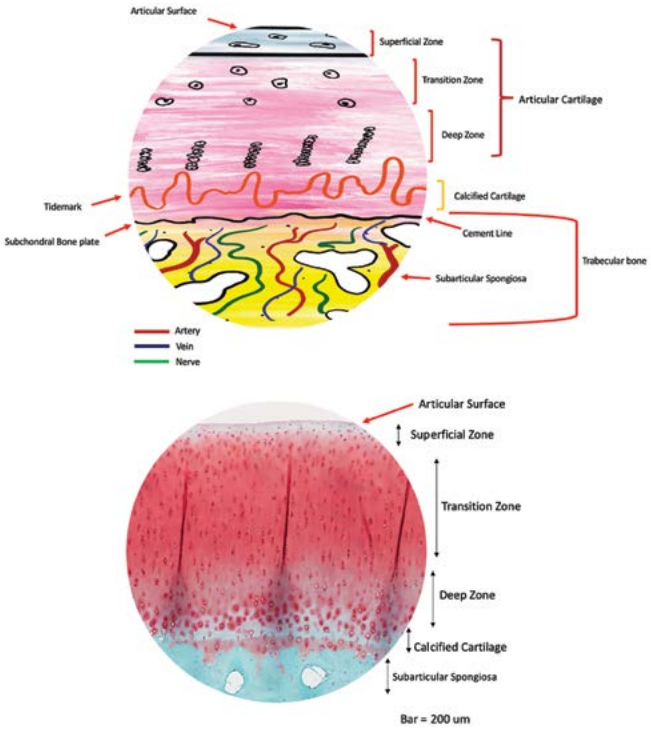
Introduction

Osteochondral lesions are a challenging clinical problem involving both the chondral and subchondral components of the articular surface. In the past, methods to treat osteochondral lesions have included osteochondral fragment fixation methods, mosaicplasty, and osteochondral autograft transfer. Because of the complex anatomy and function of the osteochondral unit, the development of a comprehensive implant has been arduous despite several experimental trials and strategies. However, with recent advances in tissue engineering technology, newer regenerative techniques have become a topic of particular interest and translational research. These trials have employed cells, growth factors, variable culture conditions, and multiphasic scaffold materials to find a regenerative implant solution for osteochondral defects.

Anatomy and Biomechanics

The basic anatomy of the osteochondral unit consists of an articular chondral component and a deeper subchondral bone component below it. Chondral tissue consists of a dense extracellular matrix (ECM) made up of water, type-II collagen, and proteoglycans. Chondrocytes and collagen fibers lie within the ECM in varying arrangements and morphologies, depending on the zone of tissue (Fig. 1). The articular chondral layer must withstand compressive, frictional, and sheer forces during cyclical joint loading. To counter these forces, cartilage functions as a biphasic tissue with both solid and fluid phases functioning with fluid-dependent and independent mechanisms.

The lower subchondral bone of the osteochondral unit consists of a subchondral bone plate, below which lies the subarticular spongiosa. The chondral and osseous layers of the osteochondral unit are divided by a chondro-osseous junction, with a tidemark separating the noncalcified and calcified layers of cartilage. As these layers are dissimilar, there are some unique structural variations that allow for better integration of the two layers (Fig. 1). This provides strength and nutrition to the chondral layers. The subchondral bone embodies many vascular canals and nerves, which allow for nutrition and nociception to the chondral tissues above, as well as compact bone, which provides strength to the osteochondral unit.



01A Schematic Illustration of the anatomy of the osteochondral unit.
01B Histological image of the osteochondral unit.

Reparative Surgical Techniques

Repair strategies for osteochondral lesions include fragment-fixation methods, osteochondral autologous graft transfer (OAT), and osteochondral allograft transplant (OCA).

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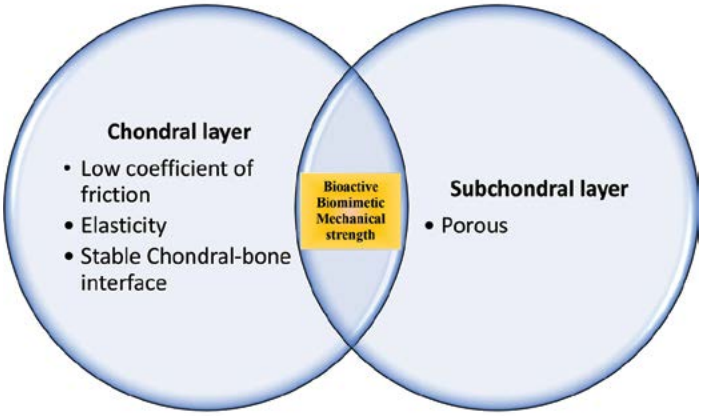
Each of these techniques has its own strengths and weaknesses, and outcomes are dependent on patient and lesion-specific variables. Table I summarizes the reparative techniques available for osteochondral lesions.

Table I. Summary of Reparative Techniques for Osteochondral Lesions

Technique	Strengths	Weaknesses
Osteochondral fragment fixation	• Intraoperative decision possible • Mature hyaline cartilage • No immune reaction • Perfect size and contour if reduced properly	• Fragment may not be viable • Dependent on fragment size, integrity, and time from injury • Implant required • Possible implant removal • Tissue reaction
Osteochondral autologous graft transfer	• Mature hyaline cartilage • No Immune reaction • Intraoperative decision possible, with no graft availability concerns • Addresses subchondral and chondral layer	• Limited quantity • Donor-site morbidity • Possible >1 surgical site
Osteochondral allograft transplant	• Mature hyaline cartilage • No limitation in size of donor graft • Immediate defect fill • No donor-site morbidity • Addresses subchondral and chondral layer	• Immunogenicity concerns • ↓ cell viability • Difficult to procure and store • Additional expense • Possible graft size mismatching

Regenerative Techniques

Regenerative approaches for osteochondral lesions have been challenging, and strategies have utilized cells, growth factors, and various scaffold materials. The solution must result in a hyaline cartilage layer supported by a material to emulate subchondral bone, and, most importantly, both materials should integrate with each other. This is the reason for the development of multiphasic scaffolds. The ideal attributes of a regenerate osteochondral unit are highlighted in Figure 2.



02 The ideal attributes of an osteochondral implant. The two layers of the implants including the chondral and subchondral areas require different properties but both must have bioactivity and mechanical strength.

Cells

Cells accomplish and mediate the bioactivity of an implant. Sources have included autologous cell biopsies as well as stem cells, and each source has its own advantages and challenges. Autologous chondrocyte biopsy was popular but lacked sufficient cell numbers. This led to in vitro expansion being advocated, which resulted in cell dedifferentiation and loss of chondrogenic phenotype. Among stem cells, the available cell types are embryonic stem cells (ESCs) and mesenchymal stem cells (MSCs); however, given the ethical obstacles associated with ESCs, MSCs have been preferred. MSCs have been isolated from several tissue sources, with bone marrow, adipose tissue, and synovium being the most popular. Among MSCs, synovium-derived MSCs are known to be superior in terms of chondrogenic and osteogenic differentiation but require considerable in vitro cell expansion for clinical use. MSCs exhibit paracrine functions, which promote cell proliferation, stimulate anti-inflammatory processes, and encourage endogenous cell recruitment, improving regenerate quality and implant integration.

The recent discovery of induced pluripotent stem (iPS) cells may allow for a new cell source. iPS cells such as ESCs have limitless proliferative potential and superior differentiation capacity, without the ethical drawbacks of ESCs, but are similar in that teratoma formation is a risk factor.

Preclinical results on the use of iPS cells have shown promise for their possible future use.

Growth Factors

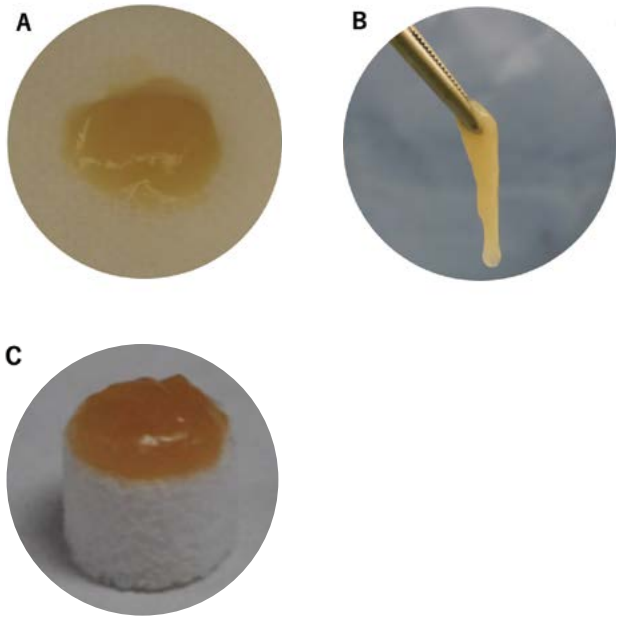
Growth factors initiate and control a large number of cellular mechanisms; as such, they are used in tissue engineering to encourage superior chondrogenesis and cell proliferation. Insulin-like growth factor, fibroblast growth factor, and the transforming growth factor-beta (TGF-β) superfamily, which consists of bone morphogenic proteins (BMP-2, 4, 6, 7), cartilage-derived morphogenic proteins (CDMP-1, 2), and transforming growth factor beta-1 (TGF-β) are mainly involved in cartilage regeneration. These factors (along with other, less-notable factors) play vital roles in promoting cell proliferation and proteoglycan synthesis and in inhibiting catabolic processes.

Because of their reparative and regenerative functions, growth factors can be used to initiate better chondral repair. Platelet-rich plasma, autologous conditioned plasma, and bone marrow concentrate are considered to be abundant in growth factors and have been used in clinical practice. These are manufactured by the concentration of blood components or bone marrow aspirate by means of a centrifugation process or a system that concentrates the native growth factors that are present within the sample. There is still uncertainty regarding whether such blood/marrow-derived products promote chondrogenic differentiation of MSCs. Although these therapies are theoretically an easily available source of growth factors, a major pitfall is that autologous therapies lack standardization.

Scaffolds

Chondral Layer

Both synthetic and natural biomaterial-based polymers have been used in the development of the chondral layer of osteochondral implants, but, because biomaterials are made from materials that naturally occur in vivo, they are less likely to result in a negative tissue response and therefore are favored. Materials such as collagen and hyaluronidase have demonstrated superior cell proliferative and differentiation results, but at the cost of being mechanically weaker. Another natural-based form of scaffolding involves the use of extra cellular matrices (ECMs), which provide a native cellular architecture that is highly bioactive. ECMs can be decellularized with use of physical and chemical methods and used to facilitate better cell differentiation. Another more recent method has been the manufacture of a cell-derived matrix from synovial MSCs, resulting in a tissue-engineered construct (TEC). TEC is highly bioactive and possesses mechanical strength as well as superior attachment properties. In preclinical studies, TEC has been combined with hydroxyapatite and beta-tricalcium phosphate to show favorable osteochondral repairs (Fig. 3)[1].



03AB TEC Macroscopic view of TEC.
03C TEC combined with artificial bone to create an osteochondral implant. (Reproduced, with modification, from: Shimomura et al. Tissue Engineering Part A. 2014 Sep 1;20[17-18]:2291-304.)

Biodegradable synthetic scaffolds such as poly(glycolic acid), poly(L-lactic acid), and poly (caprolactone) have excellent mechanical properties that can be modified during the manufacture process. This process includes their degradation rates and crystallinity. Now, with techniques such as electrospinning and 3D printing, synthetic scaffold shapes and porosities can be greatly modified. However, synthetic scaffolds have hydrophobic surfaces, which inhibits cellular attachment and reduces bioactivity. They are commonly combined with growth factors and other materials to overcome this limitation. Bioceramics have been explored for osteochondral repair as they have both osteoconductive and bioresorbable properties. In order to increase the elastic modulus of bioceramics, polymers have been added during the manufacture process. In order to improve their bioactivity, they have been supplemented with various ions (e.g., lithium, manganese, zinc).

Subchondral Layer

The subchondral layer must encounter and withstand compressive forces by having a low elastic modulus. The most commonly employed materials are metals, bioglass, and bioceramic. Metals are inert and strong but do not possess any level of bioactivity for integration with the surrounding subchondral bone. Coating them with hydroxyapatite and calcium phosphate promotes better implant integration but still does not allow for any level of degradation. The main issues associated with the use of metals are corrosion and wear particles.

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Ceramics and bioglass overcome some of the drawbacks of metals as they are osteoconductive and inductive, allowing for bonding to the adjacent native bone tissues. The implant porosity and degradation rate also can be titrated during manufacturing, but these materials are brittle and may fracture when mechanically loaded. These subchondral material alternatives must be combined with a chondral component in order to make a complete osteochondral unit.

Currently Available Osteochondral Implants with Clinical Results

At present, only three multiphasic osteochondral implants have undergone clinical trials: (1) MaioRegen (Fin-Cermica Faenza SpA), (2) TruFit (Smith and Nephew, Andover, MA, USA), and (3) Agili-C (Cartilheal Ltd, Kfar Sava, Israel). MaioRegen and TruFit have been studied more extensively than Agili-C, for which clinical trials are presently ongoing.

A recent systematic review of 16 clinical studies on the use of MaioRegen, a triphasic scaffold, included 471 subjects with International Cartilage Regeneration and Joint Preservation Society (ICRS) grade-III and IV lesions[2]. The authors of the review reported significant clinical improvement in 13 studies at 24 months of follow-up. Two studies involving histological analysis showed no residual scaffold, with a strong presence of type-II collagen and proteoglycan content in the regenerate, indicating implant resorption and an adequate regenerative tissue response. Complications included 2 cases of partial implant detachment, 2 cases of graft hypertrophy, and 52 cases of minor complications (e.g., joint stiffness and swelling). Sixteen failures were documented in the review.

In another systematic review, Verhaegan et al. reported that TruFit, a biphasic, synthetic scaffold made of polylactide-coglycolide copolymer and calcium sulphate, showed clinical benefit up to 12 months, beyond which two studies showed worsening[3]. Complications included failure of osseous ingrowth, fissured lesions on the regenerate surface, and histological evidence of subchondral cysts. TruFit appeared to have issues with biodegradability and integration and requires further improvement before further clinical application.

Agili-C, the most recently developed implant, consists of modified aragonite with hyaluronic acid and a bone phase of calcium carbonate. Preclinical data have shown excellent cell recruitment and biocompatibility. A hemicondylar aragonite implant was implanted in a caprine model, resulting in good chondral and subchondral regeneration, excellent integration, and no adverse effects at 12 months. In a case study, a 47-year-old patient underwent treatment with Agili-C and reported significant functional improvement with radiographic evidence of hyaline cartilage regeneration over the entire defect with good bone integration at 2 years[4].

Sequential radiographs suggested that the entire implant was replaced with cartilage and bone by means of creeping substitution. A more recent study of 5 talar osteochondral lesions showed good cartilage fill and reported no adverse effects at 26 months, indicating that Agili-C may be a safe option for osteochondral lesion treatment[5].

Future Directions

Osteochondral lesions have not had an adequate clinical/surgical solution. As tissue-engineering techniques and understanding of cellular differentiation mechanisms improve, research is inching closer to an answer. The clinical results associated with MaioRegen and Agili-C are encouraging, and we hope that such implants will be successful treatment options in the future. Further biological options such as TEC also look promising. With further well-designed trials and results being awaited, OATs and OCA remain techniques with respectable outcomes as long as their specific indications and limitations are noted.

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Hamstring Injury Prevention

Andre Pedrinelli, Prof.
Hospital Das Clinicas São Paulo, BRAZIL

The hamstrings are so named because of the way in which European butchers use these muscles to hang the legs of slaughtered pigs in their stores to sell. The hamstring tendons, which are composed of the tendons of the semimembranosus, semitendinosus, and long head of the biceps femoris, are responsible for hip extension and knee flexion.

Etiology

Hamstring injury is the most common injury in a variety of sports, especially those that require high running speed. It has been the most common injury in professional football for many years, with the annual incidence increasing by 4% in the elite athletes of the Union of European Football Associations (UEFA) between 2001 and 2014[1]. Hamstring injury leads to withdrawal from sporting activities and is associated with frequent recurrence. On average, a team suffers 5 to 6 hamstring injuries per season, which generates a loss of 80 days of sports activities. As such, these injuries have a considerable economic impact, given that the average cost of an injured starting player is 500,000 euros per month[2].

Hamstring injury can occur anywhere along the length of the musculo-tendinous unit. While most injuries occur in the proximal portion, at the tendon-muscle transition, avulsion of the tendon origin can also occur, in which case the treatment is typically surgical.

The injury occurs most often during eccentric contraction during a high-speed start or run. The patient frequently reports pain in the posterior thigh region, describing it as a stabbing sensation, which may or may not be accompanied by a "click." Physical examination may reveal edema, ecchymosis, and even a palpable gap due to the retraction of muscle fibers.

Evaluation and Classification

If avulsion of the tendon origin is suspected, pelvic and hip radiographs on the affected side should be made to assess the integrity of the sciatic tuberosity.

Ultrasonography and magnetic resonance imaging (MRI) are suitable methods for the diagnosis of the lesion; while ultrasonography is a cheaper and more available alternative, MRI has the advantage of being more sensitive and not being operator-dependent.

A wide variety of image classification systems are used to evaluate muscle injuries. For example, the British Athletics Muscle Injury Classification system classifies injuries into 5 grades (Grade 0 to 4), with an additional suffix of *a*, *b*, or *c* indicating whether the lesion is myofascial, tendinous, or intratendinous. Muscle injuries also are commonly classified with the Munich Classification system, which distinguishes direct injuries (bruises and lacerations) from indirect injuries and functional muscle disorders. Indirect injuries are subdivided according to the severity of the structural injury into partial injuries and (sub)total injuries, and functional changes are subdivided into overuse injuries and neuromuscular pathologies. Therefore, this classification system addresses the injury mechanism and distinguishes functional problems from structural injuries, but it does not address the injury site or whether the injury is a new injury or a recurrence.

To fill these gaps, a new classification system was proposed by the medical department of FC Barcelona and Aspetar[3]. This system is based on the mechanism of injury, the location of the injury and its relationship to the myotendinous junction, the assessment of connective tissue with imaging studies, and whether the injury is new or a recurrence. Recurrence is a very important consideration given that the most important risk factor for a hamstring injury is a previous hamstring injury. Strength is the most important modifiable risk factor, but age, flexibility, level of muscle fatigue, lumbopelvic control, quality of sports movement, range of motion, and position of the player are also risk factors.

Prevention

When formulating a prevention program, the ideal approach is to use exercises that mimic the load, range of motion, and speed experienced during sports while also correcting the greatest possible number of risk factors. The best results in preventing hamstring injuries have been achieved with use of the Nordic hamstring exercise (NH) hamstring strengthening program and the FIFA 11+ program (which uses the Nordic hamstring exercise along with other exercises). In addition, the *Get Set-Train Smarter* application (developed by the International Olympic Committee [IOC]) is a valuable clinical tool that can be used for the prevention of sports injuries, with the ability to select the prevention program according to sport or anatomical region.

Nordic Hamstring Exercise

The Nordic hamstring exercise is a double exercise that does not require special equipment. The athlete kneels on a stable and comfortable surface while the partner stabilizes the athlete's legs, keeping them against the ground.

Hamstring Injury Prevention

With the hips slightly flexed, the athlete must make a controlled descent of the trunk toward the ground, taking as long as possible through the contraction of the hamstrings, thus generating an eccentric contraction. The athlete is allowed to use the hands to cushion the fall and to push the ground to return to the starting position, thus minimizing the concentric contraction of the hamstrings (Fig. 1).

01 Nordic hamstring exercise. (Matthew Scott, Stephen Taylor, Paul Chesterton, Stefan Vogt & Daniel Lloyd Eaves [2018]. Motor imagery during action observation increases eccentric hamstring force: an acute non-physical intervention, Disability and Rehabilitation, 40:12, 1443-1451, DOI: 10.1080/09638288.2017.1300333)

FIFA 11+ Injury Prevention Program

The FIFA 11+ injury prevention program was developed by a group of international experts on the basis of their practical experience with injury prevention programs for players over the age of 14 years. This program is a complete warm-up package that should replace the usual warm-up before all workouts at least twice a week (Fig. 2).

02 FIFA 11+ Injury Prevention Program (https://kneesurgerysydney.com.au/wp-content/uploads/2017/05/FIFA-11-summary-poster.pdf)

FIFA 11+ has 3 parts, with a total of 15 exercises, which must be performed in the sequence defined at the beginning of each training session. The approximate time for execution is 20 minutes.

Part 1: Low-speed running exercises, combined with active stretching and controlled contacts between partners.

1 Straight running
2 Hips outwards
3 Hips inwards
4 Around the colleague
5 Jump with shoulder contact
6 Rapid running back and forth

Part 2: Six sets of exercises focused on core and leg strength, balance, and plyometrics/agility, all with three levels of increasing difficulty.

7 Board
8 Side board
9 Thigh muscles
10 Support on one leg
11 Squat
12 Jump

Part 3: Moderate/high-speed running exercises, combined with fixation/starting movements.

13 On the lawn
14 With jump
15 Fixing and leaving

The main elements of FIFA 11+ are core strength, neuromuscular control and balance, eccentric training of the thigh muscles, plyometrics, and agility.

Rehabilitation

The objective of a rehabilitation protocol should be to decrease the time to return to the sport, returning the athlete to the same level before the injury, without increasing the chance of a reinjury. Therefore, the rehabilitation protocol must have criteria to assess when the patient is able to progress to the next phase. These serial measures of subjective criteria (e.g., pain) and objective criteria (e.g., strength and range of motion) allow the protocol to be adjusted to the athlete and his or her responses to treatment.

Aspetar Protocol

The Aspetar protocol for soccer players[4] is an excellent guide for rehabilitation of hamstring injuries. This protocol consists of 6 stages: 3 for physiotherapy and 3 for rehabilitation in the field.

The first stage aims to promote healing of the affected tissue, the second and third stages aim to recover muscle function and neuromuscular control, and the last 3 stages reintegrate the athlete into the sport.

Askling Protocol

As most injuries occur during an eccentric contraction, muscle strengthening during treatment should focus on preparing the muscles for the specific situation that caused the injury. Askling et al. demonstrated that a hamstring strengthening protocol that focused on eccentric contractions was more effective than a conventional strengthening protocol[5], which is why the Aspetar protocol incorporates not only the protocol by Askling et al. but also the Nordic hamstring exercise.

03 The Askling protocol[5]

03A "The Extender." The player holds and stabilizes the thigh of the injured leg with the hip flexed approximately 90° and then performs slow knee extensions to a point just before pain is felt. This exercise is performed twice every day, with 3 sets of 12 repetitions each.

03B "The Diver." The exercise should be performed as a simulated dive. From an upright trunk position, the player flexes the hip of the injured (standing) leg while simultaneously stretching the arms forward and attempting to achieve maximum hip extension on the side of the lifted leg while keeping the pelvis horizontal; the angle of the knee should be maintained at 10°-20° in the standing leg and at 90° in the lifted leg. Because of its complexity, this exercise should be performed very slowly in the beginning. This exercise should be performed once every other day, with 3 sets of 6 repetitions each.

03C "The Glider." This exercise is started from an upright position, with one hand holding on to a support and with the legs slightly split. The body weight should be on the heel of the injured leg (in this case, the left leg) with approximately 10°-20° of flexion of the knee. The motion is started by gliding backward on the other leg (note the low-friction sock) and is stopped before pain is reached. The movement back to the starting position should be performed with the help of both arms, without use of the injured leg. Progression is achieved by increasing the gliding distance and performing the exercise faster. This exercise should be performed once every third day, with 3 sets of 4 repetitions each.

Communication Between Stakeholders

Although studies have shown that prevention programs that include the Nordic hamstring exercise result in a 51% reduction in hamstring injuries, only 11% of elite European teams incorporate the practice into their training. This finding may suggest that communication between the medical department and the other stakeholders, mainly the technician, must be improved, so that scientific knowledge is translated into clinical benefit for athletes and financial benefit for clubs.

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Complications Following Arthroscopic Surgery of the Hip

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Introduction

Hip arthroscopy was first described by Burman et al. in 1931, and its therapeutic use commenced in 1939[1]. Since the description of femoroacetabular impingement by Ganz et al. in the late 1990s, the number of hip arthroscopies performed each year has increased dramatically and is projected to continue to rise. Hip arthroscopy has been associated with reliable improvements in both patient satisfaction and function, and the indications for this procedure now also include extra-articular pathology (e.g. external snapping hip and abductor pathology). However, hip arthroscopy remains a technically demanding procedure that is associated with a steep learning curve and the potential for complications. As such, it is not for the occasional operator.

The aim of this article is to provide a synopsis of our systematic review of the available literature on complications during and following arthroscopic surgery of the hip. We hope that this information will be of immense value to all surgeons undertaking this procedure, especially during the process of obtaining informed consent.

Review of 36,761 Arthroscopies

Our systematic review encompassed a literature search, based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, of the PubMed (MEDLINE), EMBASE, and Google Scholar databases[2]. This review was conducted on December 11, 2016. The inclusion criteria were (1) studies evaluating hip arthroscopy only, (2) studies with all levels of evidence, (3) studies evaluating all outcomes, not just complications, and (4) studies published in English. The exclusion criteria were (1) studies evaluating combined arthroscopic and open or mini-open surgery, (2) studies consisting of the abstract only, (3) review studies, and (4) cadaveric studies.

The initial literature search identified a total of 2,381 articles. Of those, 276 relevant studies involving 35,916 patients (36,761 hips) met the inclusion and exclusion criteria. The mean age of the patients was 36.7 years (range, 1.7 to 70 years), and the mean body mass index was 25.7 kg/m^2 (range, 20.2 to 29.2 kg/m^2). The four most common indications for the procedure were femoroacetabular impingement (43.5%), labral tears (32.9%), chondral defects (8.9%), and osteoarthritis (7.1%).

A total of 1,222 complications occurred during or after arthroscopy, for an overall rate of complication of 3.3% (Table I). Neuropraxia (0.9%), iatrogenic chondral and labral injuries (0.7%), and heterotopic ossification (0.6%) were the three most common complications. There were 58 major complications (0.2%), the most common being intra-abdominal extravasation of fluid, which was found in 13 cases (0.04%). There were three deaths (0.008%).

Nerve Injury

Nerve injury was the most common complication (0.9%) in our analysis. Most cases of neuropraxia were related to traction or compression because of the perineal post, and almost all cases resolved within 3 months. Following the publication of our systematic review, there were three further reports on nerve injuries following arthroscopic surgery of the hip. Those three studies demonstrated a higher rate of postoperative nerve injury than the rate of 0.9% reported in our review (Table I). Frandsen et al.[3], in a study in which 100 patients completed a questionnaire with 25 questions related to the perception of traction-related problems, reported that 22% of the patients experienced numbness in the groin area. Reda et al.[4], in a retrospective study in which 221 patients responded to a telephone survey with four questions, reported that 37% of the patients had postoperative numbness. The authors reported the duration of surgery was a risk factor for numbness, with an odds ratio of 2.18 if the surgery took >50 minutes. Finally, Mas Martinez et al.[5] , in a study of 110 patients who were evaluated with specific questions and physical examination after hip arthroscopy, found that 62.7% of the patients reported symptoms of nerve dysfunction 24 hours after the procedure.

Table 1. Complications during and after arthroscopy of the hip

Complication	No. of Complications	Percentage of Complications (N = 1,222)	Percentage of All Cases (N = 36,761)
Nerve injury	339	27.7%	0.9%
Temporary (all)	338	27.7%	0.9%
Temporary (pudendal nerve)	110	9.0%	0.3%
Temporary (lateral femoral cutaneous nerve)	95	7.8%	0.3%
Temporary (sciatic nerve)	56	4.6%	0.2%
Temporary (common peroneal nerve)	19	1.6%	0.05%
Temporary (femoral nerve)	7	0.6%	0.02%
Temporary (unclear)	51	4.2%	0.1%
Permanent (all)	1	0.1%	0.00%
Permanent (unclear)	1	0.1%	0.00%
Iatrogenic injury	254	20.8%	0.7%
Chondral injury	140	11.5%	0.4%
Labral injury	114	9.3%	0.3%
Heterotopic ossification	219	17.9%	0.6%
Adhesion	89	7.3%	0.2%
Infection	79	6.5%	0.2%
Superficial	70	5.7%	0.2%
Deep	9	0.7%	0.02%
Other complications			
Deep-vein thrombosis	34	2.8%	0.09%
Perineal skin damage	28	2.3%	0.08%
Vascular injury (haematoma)	21	1.7%	0.06%
Broken instrumentation	20	1.6%	0.05%
Muscle pain	20	1.6%	0.05%
Intra-abdominal fluid extravasation	13	1.1%	0.04%
Anchor problem	11	0.9%	0.03%
Incomplete reshaping	11	0.9%	0.03%
Femoral neck fracture	10	0.8%	0.03%
Hip instability	9	0.7%	0.02%
Iliopsoas tendinitis	9	0.7%	0.02%
Osteonecrosis of the femoral head	7	0.6%	0.02%
Ankle pain	6	0.5%	0.02%
Arthrofibrosis	6	0.5%	0.02%
Bursitis	5	0.4%	0.01%
Hypothermia	5	0.4%	0.01%
Reflex sympathetic dystrophy	5	0.4%	0.01%
Pulmonary embolus	4	0.3%	0.01%
Snapping sound	4	0.3%	0.01%
Death	3	0.2%	0.01%
Gluteus medius tear	3	0.2%	0.01%
Hip dislocation	3	0.2%	0.01%
Dehiscence of suture	2	0.2%	0.01%
Pneumonia	2	0.2%	0.01%
Skin burn	1	0.1%	<0.005%
Total	**1,222**	**100%**	**3.3%**

Complications Following Arthroscopic Surgery of the Hip

If the traction time was >60 minutes, the odds ratio increased to 4.4 (95% confidence interval, 1.9 to 10). The rates reported in those three reports (22%, 37%, and 62.7%, respectively) were significantly higher than that in our review (0.9%). This finding certainly suggests that patient-reported outcomes do not necessarily converge with physician-measured outcomes. In addition, all of those recent studies focused on symptoms related to nerve dysfunction immediately postoperatively, and it is likely that the studies in our review evaluated the final outcome only, by which time most of the neuropraxia had resolved. Furthermore, the targeted studies in our review tended to avoid discussing sex-related complications such as neuropraxia of the pudendal nerve in younger patients, which may have led to a lower complication rate being reported compared with the more recent studies.

Distraction injuries often involve the femoral, sciatic, or peroneal nerves and may be caused by excessive traction or a prolonged traction time. It is recommended that surgeons should limit the force of traction to <50 lb (22.7 kg) to prevent these injuries[5], and the continuous traction time should not exceed 1 hour.

Iatrogenic Chondral and Labral Injuries

Iatrogenic chondral and labral injuries were the second most common complication (0.7%). A total of 30 (10.8%) of the 276 articles described chondral or labral damage; therefore, only 254 (0.7%) of all 36,761 hips undergoing an arthroscopy were recorded. Thus, it is likely that these complications were underreported.

Injury to the acetabular labrum and articular cartilage occur relatively frequently in patients undergoing hip arthroscopy. When establishing the anterolateral portal, there is a risk of puncturing the superior and anterosuperior labrum.

Iatrogenic damage to the articular cartilage normally takes place on the femoral head, especially if there is insufficient traction. A minimum distraction of 10 mm followed by an intra-articular injection of 20 mL of normal saline solution for distension of the joint is recommended at the time of creation of the first portal in order to prevent damage to the femoral head and labrum. Furthermore, when the joint is filled with 20 mL of normal saline solution, the labral silhouette is observed on the image intensifier, which also allows safe access to the joint and avoids iatrogenic injury to the labrum. If adequate distraction cannot be achieved, it is recommended that the peripheral compartment is accessed first in order to allow for the placement of a guidewire into the central compartment under direct vision.

Heterotopic Ossification

Heterotopic ossification was the third most common complication (0.6%) in our review. Heterotopic ossification may occur as a result of surgical trauma to the gluteal muscles and bone debris from the osteoplasty when treating femoroacetabular impingement. This complication can be prevented by carefully clearing any bone fragments at the end of surgery and administration of pharmacological prophylaxis (e.g., indomethacin) for 4-6 weeks. Furthermore, larger capsulotomies should be avoided in order to prevent further extravasation of bone debris; if capsulotomy is performed, then capsular closure should be followed by a thorough washout of the joint.

Conclusion

Our review of 36,761 arthroscopies indicates that arthroscopic surgery of the hip is associated with a relatively low rate of complications, although some complications may be significant in young patients. The overall rate of complications was 3.3%, and the rate of major complications was 0.2%. We hope that this information will be of value to surgeons performing this procedure and to the patients undergoing it.

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COVID-19: A Worldwide Human Perspective

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Mankind is confronting a unique moment. A single threat is testing all countries in the world. Each country is facing similar challenges that are influenced by its geography, cultural, political, and economic background.

Science is, indeed, helping us in very different ways—mainly by trying to minimize health damage, by limiting propagation of the virus, and of course, by searching for a cure. On the other hand, the Internet is keeping us informed during this period when close human contact should be kept minimal. We are facing changes on our daily life: our freedom of circulation is being jeopardized and limited in order to restrain the spread of the virus, our contact with patients is modified or nullified, and our souls are hit by fear of having the disease and being contagious to others. Governments have taken different strategies, but who knows whether these strategies are right or wrong?

In 2020, the ISAKOS Education Committee, with the full support of the Executive Board, employed its intrinsic worldwide-reaching capabilities to host a series of webinars focused on helping the global community. In each webinar, COVID-19 was present not as an educational subject but as the subject of an informal conversation between distant friends. During these conversations, it became clear that while the threat (COVID-19) and the associated worries are the same everywhere, the ways of fighting the virus are different.

We asked friends from around the world to share their personal experience of this outbreak and have been honored with their written responses in spite of their tight pandemic schedules.

Jeffrey Abrams

The corona virus has been a unique and frightening event all over the world. In the United States, the New York and New Jersey regions were the first to be severely affected. In the early months, many individuals died because of the lack of knowledge on how to treat the respiratory distress syndrome and organ failure. Although many COVID-19 patients were older, many younger health care workers were affected as well. This disease is very infectious and requires protective spacing to limit the spread. The availability of hospital beds, particularly ICU beds, was a problem. Our postoperative recovery room became a COVID Unit monitored by the anesthesiologists.

At this time, we are in a much better place, and the number of hospitalized patients with COVID has decreased. We are better equipped with knowledge, and it seems rare that someone dies of this virus. Work for an orthopaedic surgeon has returned to elective surgery in the surgery centers and hospital. Total joint replacement, arthroscopic, spinal, and extremity surgery schedules are about 85% full.

Patients still have the fear of what may happen to them during surgery, and both patients and staff continue to take precautions regarding spread.

The major differences in our lives have been social. Children are home. Restaurants are closed or only allow limited outdoor seating. Many individuals are working from home or are unemployed. There is very little traffic because of these circumstances. The beaches are pretty full as many continue to look for enjoyable ways to spend their time. We are optimistic and look forward to life returning to what we remember 6 months ago. My suspicion is that this will take another year. Hopefully, next summer will be different as normal activities are resumed, people return to work, world travel picks up, and the family unit returns to normal.

Julian A. Feller

In terms of the COVID-19 pandemic, Australia has been fortunate compared with many other countries. Being an island, we were able to close our borders relatively early, and, with only medium-density living conditions, even in the cities, outbreaks never reached the levels seen in other countries. In addition, our health system is well developed and was relatively easily ramped up to deal with an influx of patients that fortunately never arrived.

So things should be good. Indeed they are, at least in some parts of the country. But government responses are going to leave an enormous economic burden, and it may be that the "cure" may end up being seen to be worse than the disease. COVID-19 has exposed some interstate rivalries and jealousies that are deeper than many had realized and that go far beyond the banter of interstate sporting rivalries. Australia is a federation of states. Health and education are state, not federal, responsibilities, whereas aged care is a federal responsibility. So there is plenty of room to shift the blame when needed.

The early governmental response in February and March of 2020 may come to be seen as excessive, especially when compared with the current position of countries such as Sweden, which took quite a different approach. But it was understandable and certainly not unreasonable given the uncertainty as well as the dire predictions from some modelling, and it may have been a factor in our limited caseload. Case numbers and fatalities never soared and settled quickly.

But here in the state of Victoria, a so-called second wave (or "phase" to use the currently preferred term) arose out of poorly conceived and poorly implemented protocols and procedures in quarantine hotels. This factor was compounded by the fact that many of the security personnel came from lower socioeconomic backgrounds and local communities that were very susceptible to spread of the virus. This situation subsequently led to outbreaks and, not surprisingly, increased fatality rates in aged care facilities.

The state government reacted with what can only be regarded as a panicked response. Not willing to admit their role in making the decisions that ultimately allowed the second phase to occur, they became obsessed with driving the numbers of cases to unrealistically low levels, such as 0 daily new cases. This approach led to a second round of restrictions and lockdowns. Compulsory wearing of masks away from home, a curfew from 8 p.m. until 5 a.m., 1 hour of exercise per day (which has now been increased to 2 hours per day), no leaving home for other than a few reasons, no travel beyond 5 km from home, no visiting other houses or meeting friends, no attendance at schools or universities, no sporting activities, and essentially no elective surgery. The police presence is high, and fines for breaching restrictions are steep. Some have questioned how our civil liberties appear to have evaporated so easily and with so little outcry. People have become polarized in their views, and it is all too easy to be labelled as being in one camp or another.

As I write this, we are in the eighth week and our average number of new cases per day is in the low 30s (yes, 30s, not even 300s, despite the fact that Victoria has a population of 5.7 million). Hospitals have 50% bed occupancy, with only a handful of COVID-19 cases, and operating staff are looking forward to next week when we can at last recommence some elective surgery. People want to be able to work.

The effect of this second lockdown has been profound. While we accepted the measures the first time around, there is growing anger and resentment this time, especially when life in other states is quickly returning to normal. We have become a pariah state, with strict border closures imposed on us, in part driven by parochial politics and upcoming state elections. Quite apart from the impending economic destruction, the community is losing its spark. People are becoming less motivated, and depression and anxiety are on the rise. It is particularly difficult for those living on their own and those with young children living in confined spaces. Obesity (so-called COVID fat) is visibly increasing. Selfishness is growing, not lessening. Young people wonder how they will find employment. Few can contemplate the enormous financial cost and the level of debt that governments now carry, perhaps 10 times levels previously thought unacceptable. And for many rural communities, this comes on top of the devastation of last summer's severe bushfires.

In orthopaedics, this year's crop of final year trainees are unable to look forward to overseas fellowships, but there are no obvious jobs for them here next year. Surgeons in their early years of practice feel like they are back at the start. Those in sports surgery can't expect to see any sports injuries in the next 6 months. Surgeons nearing the end of their practice may find that retirement comes just a little bit earlier than anticipated.

COVID-19: A Worldwide Human Perspective

Our problems are by no means unique and, in comparison with many parts of the world, they almost pale into insignificance, although it is sometimes hard for individuals to see that. We are a lucky country, but we have not escaped the effects of this virus or the effects of our response to it.

Margaret Fok

Because of the proximity of Hong Kong with Mainland China, measures to control the spread of COVID-19 were started in late January 2020. With many locals still having the experience of SARS (2003) fresh in their memories, members of the public diligently started their preparation and precaution by stocking up food, cleaning their homes with bleaches, and wearing face masks, without being commanded by the government. Despite it being the start of the celebration of Chinese New Year, social gatherings were kept low.

In hospitals, many elective procedures were cancelled at the start of February 2020, with the priorities being given to emergency, trauma, and oncology procedures. Hospital staff were reminded by infection-control teams to be vigilant in terms of hand hygiene. Protective gear was given with specific instructions on how it should be put on and taken off in order to minimize the chances of contamination and infection. Some of the surgical wards were emptied and were converted to negative-pressure wards in preparation for potential patients with COVID-19. Measures were established for the management of patients with COVID-19 who needed emergency operations.

Although the number of confirmed cases each day was kept low (mostly <50) in this city as compared with the rest of the world, the public has remained vigilant in terms of mask-wearing and hand hygiene. Because of the population density, the public understand that any spread in the public may be disastrous. As a result, we have succeeded in not having any lockdown and only a minimal number of health-care workers have been infected with COVID-19 by working in the public hospitals.

We have gradually resumed elective procedures, although there was a period during which we kept the number of turnovers in the hospitals low (i.e., by performing one long procedure instead of a few shorter procedures). Zoom meetings and webinars have become the norm, and medical students have had to adjust to virtual learning.

With the borders being closed since March 2020, the general public has missed travelling. Yet, this enables people to slow down, spend time with their family, enjoy nature, and enjoy what the city has to offer.

Eiji Itoi

The first case of COVID-19 in Japan was confirmed on January 15, 2020, and the first case in my prefecture, Miyagi, was reported on February 28. As of September 1, 2020, we have 67,865 cases of COVID-19 nationwide and 207 cases in Miyagi prefecture. I work at a university hospital, a designated infection-control center. Many coronavirus patients have been admitted to our hospital. As a result, we needed to maintain the number of staff members in the infection unit. To that end, the Hospital Director issued a couple of orders: (1) procedures requiring postoperative care in ICU or HCU should be postponed because we need to keep the number of personnel in the infection unit (most of whom are from ICU and HCU), and (2) elective procedures should be postponed because of the lack of surgical gowns and masks. Between mid-April and mid-June, we performed no arthroplasties, no rotator cuff repairs, and no Bankart repairs; we only performed procedures for malignant tumors and paralytic / paretic cases. We are gradually resuming elective procedures. All patients must undergo mandatory PCR testing for COVID-19 before surgery in our hospital. In terms of the number of new cases (as of September 1, 2020), we are in the middle of the second wave. The death rate caused by this virus is 1.9% in Japan. The problem is that the more patients we accept, the worse the financial status of our hospital becomes. We are requesting the government to support the institutes in which coronavirus patients are being treated.

My professional life has changed dramatically. I used to travel abroad to attend international meetings and invited lectures almost every month. In addition, I used to travel extensively for domestic meetings and lectures. All of these activities have been cancelled, postponed, or changed to virtual. In January of 2020, everything was normal; I attended the Board-Certified Examinations of Japanese Orthopaedic Association in Kobe (a 1.5-hour flight from Sendai) as well as two local meetings in Sendai. However, the first coronavirus case in Japan was found in January and the cruise ship "Diamond Princess" was anchored in Yokohama harbor in early February after a passenger tested positive for the virus. The virus was confirmed in one passenger after another, ultimately affecting >700 passengers from this cruise ship. A great fear of the virus rapidly spread throughout the country. In early February, I had a plan to attend the Nepal / Japan Combined Orthopaedic Symposium in Kathmandu, Nepal, but, because of the fear of coronavirus, I cancelled the trip. I also was invited to the International Biennial Congress of Iranian Society of Knee Surgery, Arthroscopy, and Sports Traumatology in Kish Island, Iran, in mid-February, but that meeting was postponed because many invited speakers started to cancel their trips. From February 2020 until now (September 2020), I have not traveled anywhere in the world, not even to Tokyo; I have just stayed at home and continue to go to my university on a regular basis.

Of course, I have no schedule on my calendar during my travel period. That means I have more time to concentrate on my own work. As I am retiring from the university next March, I am writing a monograph entitled “Shoulderology: It’s Fun to Solve Clinical Questions and Know More About Shoulder” to give inspiration and encouragement to the young generation. Because of this pandemic, I have been able to spend most of my time during the last 6 months writing this monograph, and finally I have completed the draft! This was a great blessing for me.

In our department, a weekly clinical conference has been held on-line since March 2020 in order to maintain social distancing. Professors' ward rounds and weekly journal club meetings have been cancelled for the same reason. We have very limited contact with each other. Tuesday is my clinic day. The number of patients coming into the clinic has decreased because of the fear of catching the virus. Every week after the clinic, I have lunch with a doctor who helps me to fill out the patients’ electronic charts. In the staff cafeteria, we sit at a table with an acrylic board between us. This looks quite strange, but this is our new lifestyle.

Our daily lives have changed as well. I have not dined out with my family or with my colleagues for the last 6 months. In other words, I have had dinner with my wife at home every day for the last 6 months. This never happened during 34 years of marriage. It is the same for my colleagues. I have made it a rule to go grocery shopping with my wife every Saturday. The grocery stores have placed hand sanitizers at the entrance and at the exit. They have separated the entrances and exits to promote social distancing. Whenever we go outside, we are asked to wear a mask. This summer, the beaches and pools were closed. We could not go anywhere. Instead, we have much time at home, reading books, watching TV, listening to music, and weeding in the backyard during the weekend. I think most of my colleagues and their families are more or less the same. We have now more family time and less social time. Now is the time to consider how to use this newly allocated time of our daily living more wisely and fruitfully because we never know how long this pandemic will last.

Manuel Mosquera

It happened 7 months ago, but it seems like yesterday. I was in Santiago de Chile as a participant in our SLARD international congress, and the news media from around the world was talking about the dire situation, with Italy and Spain trying to control the spread of coronavirus and the high incidence of death. I remember sitting in a café with some friends from Spain who were attending the congress as speakers; we had all heard the rumors that Chile would close its borders and my friends began to worry that they would not be able to return to their families. My advice to them was they had to leave Chile as soon as possible even if they could not give their lectures; fortunately, they did so and returned to Spain that same night.

Early the next day, Chile’s president announced its closure of its borders to Spanish people! My friends had made the right decision; meanwhile, I started to worry about my return to Bogota that was scheduled for the next Saturday at 15:00 hours. After the conclusion of the congress, we were able to take our flight to Colombia. Because I felt exposed to the contact with many people during the meeting and in the airport and plane, I decided to isolate myself for two weeks in order to prevent any risk of exposing my family, coworkers, and friends. Nobody understood my decision, and all argued that it was hasty, but when the days began to pass and the news of multiple cases of COVID were present in Bogota, they understood my reasoning.

My isolation coincided with the quarantine decreed by the government, which meant that I had to close my office and surgery for 3 months. Having so much free time motivated me to work every day on my action plan as president of SLARD in conjunction with the executive committee and the new board of directors. As a result, we quadrupled the number of members, we included all orthopaedic societies and/or associations related to the objectives of the SLARD to be inclusive of all Latin American countries. We spent 2 months developing webinar programs and invited our colleagues from all countries to participate in conferences focusing on topics that are controversial in our professional practices, with international colleagues from different continents serving as opinion leaders. We also began to develop a new website in accordance with the needs of our society and launched our SLARD e-newsletter, which focuses on news from the society, clinical cases, surgical techniques, and so on. Finally, we defined the dates of our congresses in Panama and Cartagena for 2021 and 2022, respectively.

During this unprecedented period in our academic history, we were able to refine 5 consensus statements on controversial and frequent topics, with final round of discussions scheduled to take place during the first Latin American Meeting of Arthroscopy, Joint Reconstruction, and Sports Trauma, to be held in Panama on July 29-31, 2021.

While I learned many things during this long isolation, one of the main lessons is that we are very fragile because a microorganism that we do not even have the ability to see has put all of humanity at high risk, killing many people without warning. I also learned that simple things are full of value in our daily lives. We don’t need a lot of money to be happy, because luxuries in these circumstances neither make sense nor have value. But perhaps the best lesson of this pandemic is to reaffirm that nothing and no one is more important than God and family, which in our life before COVID was left in the background because we believed that our jobs are the main thing. How wrong we were!

ACL Reconstruction 2020: A Worldwide Survey

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Introduction

Anterior cruciate ligament reconstruction (ACLR) is one of the most frequently performed surgical procedures involving the knee, with an extensive amount of literature dedicated to its research. Still, there is no consensus regarding the technical aspects of the surgical procedure (e.g., technique, graft choice, fixation method, and so on). Surgeons plan their ACLR procedures on the basis of their own personal experience, the available evidence, the preferences of their peers, and local trends. To date, several local surveys have summarized the current trends and common practices for ACLR in different countries[1,2]. To our knowledge, none of the previous ACL surveys have evaluated surgeons' preferences worldwide.

The Survey: Methods & Results

The ISAKOS Knee Sports & Preservation Committee conducted an online survey comprising 16 questions regarding selected issues related to ACLR. The survey was sent out to all ISAKOS Members during May 2020 (Fig. N.1). Of the 3,026 questionnaires that were delivered, 2,130 were completed (response rate, 70.4%), representing the largest ACLR survey reported to date. The numbers of answered questionnaires according to region were as follows: Asia & Oceania, 949 (45%); Central and South America, 532 (25%); Europe, 382 (18%); North America, 238 (11%); and Africa, 29 (1%). The main findings of this survey are summarized in Table I. Hamstrings autograft was the leading option for primary ACLR (64% of surgeons), followed by patellar tendon (21%). A medial portal drilling technique for the femoral tunnel was preferred by 78% of surgeons. Cortical buttons were the favored option for femoral fixation of hamstring grafts (82% of surgeons), and bioabsorbable screws were the favored option for the tibia (62%). For both tibial and femoral fixation of patellar tendon grafts, the preferences were split between metallic screws (45% for the femur and 47% for the tibia) and bioabsorbable screws (38% for the femur and 48% for the tibia). Prophylactic antibiotic soaking of the graft was endorsed by 45% of surgeons, and graft pre-tensioning was endorsed by 64%. The majority (57%) of surgeons positioned the knee between 10° and 30° of flexion and neutral rotation for graft fixation, and return to play was permitted at an average of 9.1 months. An anterolateral augmentation (or extra-articular tenodesis) was added to 10% of primary and isolated ACLRs and 36% of revision ACLRs. More than half (55%) of the responders indicated that they used a postoperative brace for isolated ACLR, and the average time for return to play was 9 months.

Table I. Survey Findings*

	ISAKOS Survey 2020	Asian Consensus 2016	Argentina Registry	North America: ACL Study Group Survey	Sweden Registry	UK Registry	New Zealand Registry
Surgical volume							
Dedicated >50% of practice to knee surgery	66%	NA	NA	NA	NA	NA	NA
Performed >25 ACLRs/yr	81%	100%	NA	NA	38.8%	Only 1 surgeon performed >60 ACLRs/year	20.80%
Preferred graft for isolated primary ACL							
Hamstrings	64%	90%	77.40%	25%	84.9%	90%	73.50%
BTB	21%	0	19.20%	59.40%	7.5%	9%	21.40%
Quadriceps	6%	10%	1.60%	15.60%	6.0%	36 cases	2%
Preferred technique for femoral tunnel drilling							
Anteromedial portal	78%	50%	71.60%	53.10%	89.8%	75%	72.30%
Transtibial	11%	30%	27.90%	25%	6%	5%	10.30%
Retro-drilling	11%	20%	0.50%	12.50%	1.8%	20%	1.10%
Graft fixation system							
Femoral fixation of hamstrings grafts	82% cortical button	90% cortical button	70.4% cortical button	NA	93.5% cortical button	NA	95% cortical button
Femoral fixation of BTB grafts	45% metallic screw, 38% bioabsorbable screw	NA	95% screw	NA	74.8% metallic screw, 24.5% cortical button	NA	73% metallic screw
Tibial fixation of hamstrings grafts	62% bioabsorbable screw	90% aperture fixation	87.6% screw	NA	32.2% cortical button, 22.8% post fixation, 18.6% bioabsorbable screw, 13.9% metallic screw	NA	54% cortical button
Tibial fixation of BTB grafts	47% metallic screw, 48% bioabsorbable screw	NA	96% screw	NA	81.6% metallic screw, 8.7% bioabsorbable screw	NA	85% metallic screw
Used graft pretensioning techniques	64%	NA	NA	NA	NA	NA	
Presoaked graft in antibiotic solution	55%	NA	NA	NA	23%	NA	8.50%
Position of knee for graft fixation							
10°-30° knee flexion and neutral rotation	57%	NA	NA	55%	NA	NA	NA
Full extension and neutral rotation	23%	NA	NA	25%	NA	NA	NA

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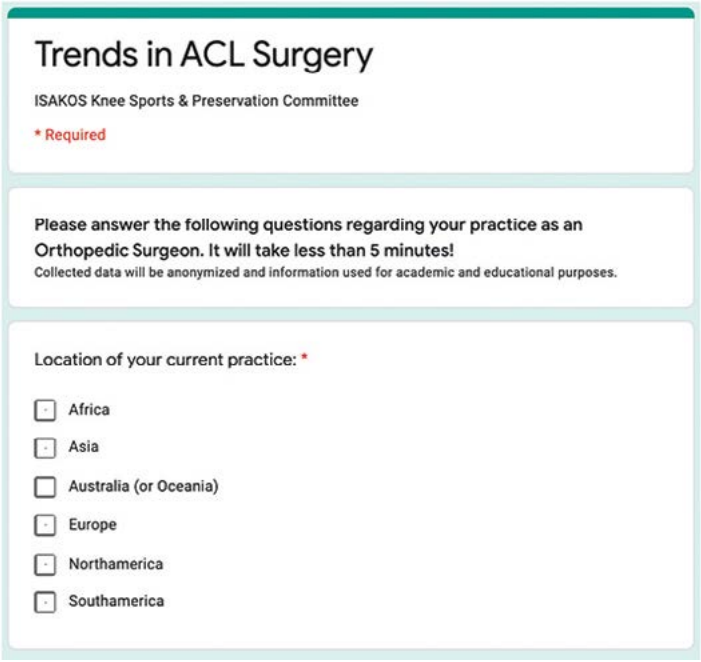
	ISAKOS Survey 2020	Asian Consensus 2016	Argentina Registry	North America: ACL Study Group Survey	Sweden Registry	UK Registry	New Zealand Registry
Percentage of lateral extra-articular tenodesis							
Added in isolated primary ACL	10%	NA	NA	25% never, 59.4% rarely, 15.6% sometimes	0.6%	NA	NA
Added in revision ACL surgery	36%	NA	13.78%	19.35% never, 32.36% rarely, 32.26% sometimes, 16.13% often	6.80%	NA	NA
Average time to return to sports	9 months	NA	NA	> 6 months	NA	NA	NA
Indicated postoperative brace	55%	100%	NA	74%	NA	NA	NA

*NA = not available.


Trends in ACL Surgery

ISAKOS Knee Sports & Preservation Committee

* Required

Please answer the following questions regarding your practice as an Orthopedic Surgeon. It will take less than 5 minutes!

Collected data will be anonymized and information used for academic and educational purposes.

Location of your current practice: *

- Africa
- Asia
- Australia (or Oceania)
- Europe
- Northamerica
- Southamerica

01 Trends in ACL Surgery

The goal of this survey was to delineate surgeons' preferences for ACLR by summarizing the current trends around the globe. This large cohort also allowed for comparison of our results with those of regional registries and local surveys in order to highlight differences and similarities, as described below.

New Zealand ACL Registry

The New Zealand ACL Registry was successfully established nationwide in 2014, with the goal of recording all locally performed ACLR procedures. By 2019, this registry database had almost 10,000 patients. Surgeon participation is voluntary and currently captures approximately 75% of the estimated 3,000 ACLR procedures performed in the country annually. Patient-reported outcome measures (PROM) data (Knee Injury and Osteoarthritis Outcome [KOOS] and Marx scores) are collected from patients preoperatively and at 6 months, 1, 2, and 5 years, with the surgeon recording the intraoperative data immediately following the surgery and self-reporting any complications that arise in the following 5 years. Dataset completeness is high for the intraoperative data, but the young, mobile ACLR population makes long-term follow-up difficult everywhere. Here, the benefits of being a small island nation also come to the fore, with the 2-year follow-up rate of 70% comparing favorably to those of other mores established registries (~50%).

Similarities

A direct comparison between the NZ registry and the worldwide survey shows that the NZ experience is reasonably similar to the worldwide trends in terms of graft choice and drilling technique.

Hamstring autografts are the most common grafts (73.5% in NZ vs. 64% worldwide), followed by bone-patellar tendon-bone [BTB] grafts (21.4% in NZ vs. 21% worldwide).

Quadriceps tendon is currently only used in 2% of NZ cases, compared with 6% worldwide, but recently there has been significantly increased use of this type of graft, reflecting the worldwide trend. Allograft is used in <1% of procedures in NZ, compared with 4% worldwide. Transportal femoral drilling technique is predominant (72.3% in NZ vs. 78.4% worldwide), with almost the same proportion utilizing a transtibial approach (10.3% vs. 11%). The worldwide survey indicated that 10.5% of surgeons use a retrodrill-type technique, and while this technique is used in only 1.1% of NZ cases, a significant proportion (16%) of surgeons in NZ have not described their technique, which may account for this discrepancy.

Differences

There are several differences between the NZ data and the worldwide survey. The first difference is in surgeon case volume. Worldwide there is a fairly even spread between low, medium, and high-volume ACL surgeons, whereas in NZ there is a definite preponderance toward a larger number of low-volume surgeons, with approximately 8 of 10 ACLRs being performed by surgeons who do <25 cases annually and over half being performed by surgeons who do <10 cases annually. Another significant difference is that antibiotic graft soaking is used in only 8.5% of ACLRs in NZ, compared with more than half of the cases in the worldwide survey. Tibial fixation for hamstring grafts differed significantly as interference screw fixation was predominant in the worldwide survey (77% [62% bioabsorbable + 15% metallic screws]), whereas cortical suspensory fixation was used in over half (54%) of NZ cases. Another striking feature is the regional difference in the type of screw used; worldwide there is fairly even split between metal and bioabsorbable screws for BTB grafts, whereas in NZ there is extremely low use of bioabsorbable screws (used in only 1% and 2.5% of cases on the femoral and tibial sides, respectively, compared with 73% and 85% for metal screws in the same locations).

North America ACL Study Group Survey

In January 2020, the most recent International ACL Study Group survey was distributed to the membership ahead of the biennial meeting in Kitzbühel, Austria. The survey consisted of 87 questions and 16 categories, addressing common practices relating to ACL injury and surgery. A total of 140 responses were received, 38 (27%) of which were from North American surgeons; those responses are the focus of this section. Care must be taken when interpreting these data as opposed to national registry data as the group consisted of high-volume subspecialists in knee ligament surgery.

Similarities

There are a few similarities between North American surgeons and the rest of the world. The majority of surgeons use anteromedial portal drilling for the femoral tunnel (53.13% for North America, compared with 78.4% worldwide).The majority of surgeons around the world (55%) and in North America (74.19%) use postoperative bracing for ACLR. Additionally, the majority of surgeons worldwide do not routinely add extra-articular procedures during primary (10%) or revision (36%) ACLR. Most North American surgeons (84%) never or rarely use lateral tenodesis for primary ACLR, whereas 48% sometimes or often utilize lateral tenodesis for revision ACLR.

Differences

Graft choice for primary ACLR is a large difference between North American surgeons and the world. The most popular graft in North America is BTB autograft (59.38% in North America vs. 21% worldwide). The second most popular graft choice is hamstrings autograft (25% in North America vs. 64% worldwide). The transtibial technique was twice as common among North American surgeons compared with worldwide (25% vs 11%). The majority of North American surgeons (51.6%) allow return to play after 6 months, whereas the most popular answer in the worldwide survey was 9 months.

Sweden and UK National Ligament Registries

The Swedish National Knee Ligament Registry (SNKLR) (established in 2005) has two sections: (1) a section in which surgeons report baseline and surgical data and (2) a section in which patients report PROMs preoperatively and at 1, 2, 5, and 10 years after surgery. From 2005 to 2019, 49,095 primary ACLRs were registered. Currently, surgeon compliance in reporting baseline and surgical data is excellent, with >90% of ACLRs registered.

The UK National Ligament Registry (UKNLR) (established 2013) requires contributions from both surgeon (baseline and surgical data) and patient (PROMs preoperatively and 6 months as well as 1, 2, and 5 years postoperatively). From December 1, 2012 to December 31, 2019, 11,861 primary ACLRs were registered. Sadly, surgeon compliance is low (<10%). For comparison to the present survey, surgical data from the year 2019 were extracted from both registries (including 3,951 primary ACLRs from the SNKLR and 1,856 from the UKNLR).

Similarities

In both countries, hamstrings tendon (HT) autograft is the most commonly used type of graft (84.9% in Sweden and 90% in the UK vs. 64% worldwide), followed by BTB graft (7.5% in Sweden and 9% in the UK vs. 21% worldwide). Quadriceps tendon usage in Sweden (6%) is comparable with that worldwide (5.6%). Allograft is used in 0.8% and 1% of Swedish and UK reconstructions, respectively, compared with 4% worldwide.

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The most common femoral drilling technique is via the anteromedial portal in both countries (89.8% in Sweden and 75% in the UK vs. 78.4% worldwide). In Sweden, BTB grafts are usually fixed with interference screws both in the femur (74.8% vs. 83% worldwide) and in the tibia (90.3% vs. 95% worldwide). The most common femoral fixation method for HT grafts is a cortical button (93.5% vs. 82% worldwide). No data on graft fixation are available from the UK.

Differences

Surgeon case volume varies considerably. In Sweden, compared with worldwide, there is a higher prevalence of low-volume surgeons (<25 ACLRs / year) (61.2% vs. 18.8%) and a lower prevalence of high-volume surgeons (>75 ACLRs / year) (6.1% vs. 29.7%). The UK data do not reflect reality because of the poor surgeon compliance, and the registry records only one surgeon who performed >60 ACLRs / year and a high prevalence (40.4%) of surgeons who performed ≤10 ACLRs / year.

In Sweden, the most common tibial fixation method for HT grafts is a cortical button (32.2% vs. 13% worldwide), followed by a screw post (22.8% vs. not reported worldwide). Other significant differences are the lower rate of graft presoaking in an antibiotic solution (23% in Sweden vs. 45.4% worldwide) and anterolateral augmentations performed in primary ACLR (0.6% in Sweden vs. 10% worldwide) and revision ACLR (6.8% in Sweden vs. 36% worldwide). No data on graft fixation, graft presoaking, and anterolateral augmentations are available from the UK.

Asia Consensus 2016

Asia is home to the largest population in the world, and the medical infrastructure is extremely diverse because of prevailing sociopolitical variations. This region does not have a sports surgery registry or an ACL study group, so data from the current survey will be compared with the results of the Asian Consensus Meeting of 2016[3]. This is a major limitation in comparing the two datasets because a consensus meeting is likely to be less representational.

Similarities

The overwhelming favorite graft for primary ACLR was the hamstrings in the worldwide survey (mean, 64%), which was consistent with the Asian perspective. Allografts were used by very few surgeons in Asia, especially because of nonavailability in several countries. Femoral fixation of the hamstrings graft was achieved with use of a cortical button by 90% of respondents, and tibial fixation was achieved with use of a bioabsorbable screw by 90% of respondents, rates that are similar to those in the worldwide survey.

Differences

A major difference was the profile of participants in the current survey as compared with the previous consensus meeting. Of the 794 respondents in the worldwide survey, almost half (49.9%) reported that they have been performing ACL surgery for 6 to 15 years; however, only one-third (30.1%) of all respondents reported that they performed >75 ACL procedures per year. In contrast, the consensus group comprised 10 surgeons who reported performing high-volume knee arthroscopy for >15 years. While 85.7% of surgeons in the current survey reported that they perform anteromedial portal drilling for the femur, this rate was only 50% in the consensus paper. Respondents to the world survey reported that an extra-articular anterolateral augmentation procedure is performed in about 10% of primary ACLRs and 36% of revision ACLRs; in contrast, 67% of respondents in the Asian consensus group were in favor of an extra-articular procedure for grade-3 pivot and all were in favor of adding it to every revision ACLR. While only 55% of the respondents to the worldwide survey use bracing following ACLR, 100% of surgeons in the Asian consensus paper used bracing following ACLR. In the worldwide survey, return to play was allowed after a mean of 9 months, whereas the respondents in the Asian consensus group agreed only on an objective criterion, which was not time-bound.

South America: Argentina ACL Registry

In the ISAKOS survey, the response rate among South American surgeons was 77% (532 of 689). This is an encouraging result, particularly in light of the fact that there is no registry for the whole region and the fact that Argentina is the only South American country with a national registry. This voluntary web-based Argentinian ACL Registry was created in 2017 following the guidelines of the Scandinavian Registry. The survey has been modified for regional convenience. Between 2017 and 2019, 5,460 ACLRs were uploaded to the registry by 168 hospitals and clinics.

Similarities

The results regarding graft choice were similar in the Argentinian registry and the ISAKOS worldwide survey, with hamstrings autografts leading as the preferred graft (76% in Argentina vs. 64% worldwide), followed by BTB grafts (19% in Argentina vs. 21% worldwide). Regarding femoral tunnel drilling technique, the main choice by far was the use of anteromedial portal for both the Argentina registry (71.6%) and the ISAKOS survey (78%). Femoral fixation of hamstrings graft was achieved with a cortical button in 70.4% of cases in Argentina and in 82% of cases worldwide, followed by interferential screws in 27% and 8%, respectively. When BTB graft was chosen, both records showed 95% usage of interference screws (the Argentina registry does not record the type of screw used).

Differences

The rates of usage of quadriceps tendon graft and allograft for ACLR were slightly lower in the Argentinian registry (2.5% and 1.5%, respectively) than in the ISAKOS survey (5% and 4%, respectively). While transtibial drilling is still common in the Argentinian registry (28%), a low incidence was reported in the worldwide registry (11%). There is little experience with retro-drilling technique in Argentina (1% compared with 10.5% worldwide), mainly because of the high costs. There is no record of surgeon case volume, graft pretensioning, antibiotic solution graft presoaking, or knee positioning for graft fixation in the Argentinian registry.

Reflections and Summary

Looking at the comparison between the ISAKOS survey and the local / regional summaries, there is no doubt that similarities are more common than differences. One obvious reason for this finding is the globalization of medicine as reflected by international collaboration and the ISAKOS mission itself. Surely, key opinion leaders in different parts of the world have influenced tactics in graft choice and fixation methods to some extent, but the conformity that this survey reflects is still a state of the art and consensus proposal in itself. Furthermore, the majority (approximately 80%) of the survey respondents performed >25 ACLRs per year and 50% performed >50 ACLRs per year, reflecting a good level of experience among the respondents who in many regions likely serve as key opinion leaders.

Some strategies have definitely changed over the years. For example, medial portal drilling demonstrated a high prevalence across surveys and registries. Other treatment tactics that have gained popularity over the last years include the use of vancomycin for soaking the graft and adding an anterolateral procedure in ACLRs. Surprisingly, half of the surgeons still increase the total cost by using a brace postoperatively after a primary ACL reconstruction, despite the lack of obvious evidence-based benefit.

The definite strengths of the present survey (which we believe to be the largest benchmark study in the world to date) are the high response rate and the high numbers of responses. A potential weakness is that the survey primarily addresses dedicated ACL surgeons and not the great number of surgeons worldwide who do not participate in academic international medicine collaborative work. Nevertheless, most low-volume surgeons are influenced by national key opinion leaders, many of whom are thought to be represented in this survey. The encouraging summary, when looking at the great survey response as well as different continent approximations, is indeed the establishment of a 2020 reference platform for current and future comparisons.

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Interpreting Registry Data and Its Effect on a Surgeon's Decision to Change Implants

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With >30 countries having national joint replacement registries, registry data are increasingly prevalent. However, interpretating the data related to prosthesis and technique choice can be problematic. Decades of TKR design innovation have resulted in a large number of variations in prostheses and surgical techniques. Recently, we defined surgeon preference with respect to those variations as "choosing a particular technique or implant to maximise surgeon-assessed attribute utility (i.e. value) within the parameters of accepted standards and regulation" while recognizing that the drivers for surgeons to change their preferences remain uncertain. In an era of patient-centric care and increasing arthroplasty costs, these drivers of preference deserved further examination.

What Constitutes Practice-Changing Evidence?

There is a lack of a definition for what constitutes surgeon-assessed attribute utility, and moreover, what constitutes universally accepted practice-changing evidence. The advantages of different clinical, observational, and experimental trial outcome data types are debatable, but none is without disadvantage and potential bias. Case series, particularly by designer-surgeons, suffer confounders such as performance bias and selection bias, whereas randomized controlled trials are typically underpowered to show small but clinically important differences and can lack generalizability. The validity of proxies for TKR survivorship such as radiostereometric analysis remains uncertain as they only examine prosthesis fixation stability; similarly, the clinical applicability of kinetic and kinematic analyses as proxies for patient function is also problematic.

Registry data are pragmatic and comprehensive; however, they are observational in nature, and, as a result, can also be affected by confounders. Nonetheless, such data can be used to perform unique studies that no other technique can accomplish. Registry confounders include patient-related factors, surgeon-related factors, surgical technique, and prosthesis design.

Interestingly, in the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR), prosthesis selection is the dominant factor when a surgeon's revision risk is above the 99.7% confidence limits when examined in funnel plots compared with the mean.

Novel methods can be utilized to control for the confounders inherent in observational registry data. Matched-prosthesis analysis is a method to pragmatically compare two prostheses while controlling for variables such as fixation type, polyethylene type, and patellar resurfacing status. A recent matched-prosthesis analysis in which oxidized zirconium was compared with cobalt-chrome as a bearing surface demonstrated that the more expensive zirconium offered no advantage[1]. Another method, instrumental variable (IV) analysis, allows pseudo-randomization of registry data. Surgeon preference for a particular style or design of prosthesis is an accepted instrumental variable as it satisfies three key assumptions: (1) it is associated with the exposure under study, (2) it affects the outcome only through the exposure (exclusion restriction), and (3) it is independent of confounders. Recently, IV analysis was used to examine how the risk of revision is affected by surgeon preference for posterior-stabilized TKR, selective patellar resurfacing, and hybrid fixation[2]. One other advantage of using surgeon preference in an IV analysis, besides allowing for pseudo-randomization of observational data, is to potentially improve surgeons' cognitive synthesis by directly linking their preferences to subsequent revision risk.

Other methods of controlling for confounders are also utilized, such as cohort stratification and risk adjustment, matched-patient cohorts, and propensity score matching. Recent registry studies using these methods have demonstrated a higher risk of infection in association with posterior-stabilized TKR.

Recognizing that not all confounders can be eliminated from purely observational data, some registries have commenced registry-nested randomized trials. The CRISTAL trial, a cluster randomized, crossover, non-inferiority trial of aspirin compared with low-molecular-weight heparin for prophylaxis against venous thromboembolism in patients undergoing hip or knee arthroplasty, is one such study that is currently underway.

Catalysts for Change

Surgeons can decide to change their prosthesis in response to a variety of catalysts. However, the tipping point for preference change by an individual surgeon is complex and multifaceted and is altered by factors such as surgeon barriers, institutional barriers, surgeon cognitive biases, heuristics, data source, and data ownership.

Cognitive biases that act as barriers include confirmation bias (interpretation of data that confirms pre-existing beliefs), anchoring (overweighting first piece of information that we receive), neglect of probability, availability bias (overweighting evidence that we have personally observed), and conservatism or decision inertia.

TKR options in which the potential or theoretical design advantages of an option are outweighed by its actual disadvantages represent a "developmental dead-end." Conversely, the continued use of an option despite evidence of no benefit at a higher cost, or actual higher risk, represents an "evidence-utilization incongruity." Unfortunately, the lack of a universally accepted definition of practice-changing evidence, as detailed above, makes these concepts more theoretical than practical.

Is Revision Risk a Viable Outcome Measure?

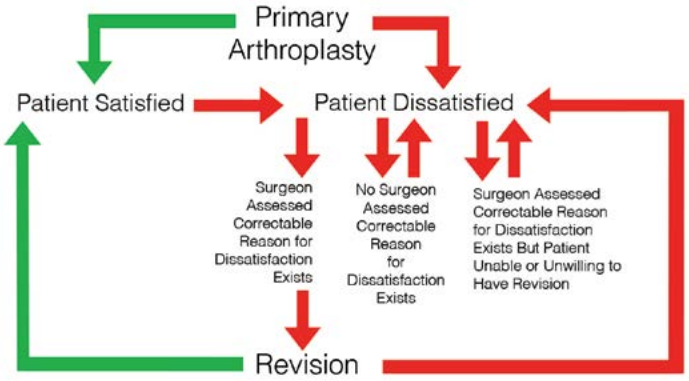
When considering the variety of TKR prosthesis options that are available to surgeons, it must be recognized that these options often interact in terms of revision risk, and hence, cannot be examined in isolation. For example, AOANJRR data indicates that cementless fixation and patellar non-resurfacing are associated with a much greater risk of revision when used in Posterior Stabilized TKR than when used in Cruciate Retaining / Minimally Stabilized TKR. As revision TKR is an expensive procedure, with greater risks and worse functional outcomes than primary TKR, measures to reduce the rate of revision with optimum prosthesis selection are vital, particularly when no identifiable clinical advantage exists between alternative design options.

As discussed, registry data represent comprehensive and pragmatic information on the mean prosthesis revision rate, but direct prosthesis comparisons are at a risk of confounding bias, despite revision risk being adjusted for age and gender. Recognition of this confounding bias may represent a possible explanation of why, in a recent survey of members of the knee societies of Australia, New Zealand, Britain, and South Africa, 20% of surgeons responded that they disregard registry data when choosing their preferences. It is difficult to reconcile some surgeons' stated disregard for revision risk as an attribute as it is not independent of other attributes. As an illustration, patients without infection who have adequate fixation, acceptable pain, functional range of motion, and stable implants will have lower revision rates than those with poor flexion, stiffness, infection, and loosening.

Doctor, I'm Not Satisfied

Patient dissatisfaction due to both prosthesis and non-prosthesis-related factors remains a challenging issue in a subgroup of patients, estimated to represent between 1% and 17% of those who undergo TKR. Prosthesis-related factors that have been linked to patient dissatisfaction include ongoing pain, poor flexion, poor function, instability, infection, and component loosening.

While patient satisfaction rates are increasingly being investigated by both clinical investigators and health-care funders, the relationship between revision rates and patient dissatisfaction rates remains complex[3], correlating with unmet expectations, ongoing pain, and complications. To perform a revision, the surgeon obtains consent from the patient to replace all or some of the components of the prosthesis to correct a valid identified underlying problem. Assuming that a surgeon-assessed correctable problem exists and the patient is able and willing to undergo a revision, this consent to proceed with revision represents a reasonable proxy for a patient's dissatisfaction exceeding the threshold at which it warrants another procedure with its associated risks, costs, and discomfort (Fig. 1). It should be noted from Figure 1 that patients who undergo revision represent a subset of those who are dissatisfied, as those who do not have a surgeon-assessed correctable problem and those who have a surgeon-assessed correctable problem but are unable or unwilling to have a revision are not represented. It is likely that these dissatisfied patients who do not undergo revision will be evenly distributed across all groups examined. Moreover, the lack of a surgeon-assessed correctable problem does not mean that no problem exists with the implant, just that one has not been identified. Finally, some patients who require a revision may not be dissatisfied, such as those requiring revision for late infection, fracture, or late loosening of a previously well-functioning implant.



01 Flowchart of Interaction between Dissatisfaction and Revision

With registry data, the reasons for revision are provided by the revising surgeon, who may or may not be the primary surgeon. In order of decreasing frequency, the listed reasons for revision in the AOANJRR are loosening-lysis, infection, patellofemoral pain, pain and instability, patellar erosion, arthrofibrosis, fracture, malalignment, tibial insert wear, metal-related pathology, incorrect sizing, and "other". Given that a large majority of these reasons are altered by the primary surgeon's implant choices, surgeons disregard the registry revision risk of their preferred prosthesis at their patient's peril.

Interpreting Registry Data and Its Effect on a Surgeon's Decision to Change Implants

Should the Comparator be the Average or the Best?

When surgeons currently examine their own revision risk, or the revision risk of a particular prosthesis or technique, they typically compare it with the average revision risk for all prostheses in the registry. The main disadvantage of this average-comparator approach is that it enables surgeons to maintain a preference for prostheses and techniques that have a higher risk of revision in comparison with other options that have clinically similar outcomes but a lower revision risk. A surgeon with a preference for an option with a higher revision risk may inadvertently form the opinion that their preferred implant choice is acceptable as it is being compared with the mean for all implants rather than to the mean for the lowest-risk implants.

A novel alternative approach would be that of a hypothetical "Optimum Prosthesis Combination" (OPC), defined as a TKR that has the lowest revision risk option for five primary TKR design element categories: fixation, posterior stability, bearing mobility, bearing surface, and patellar resurfacing[4]. "Alternative Prothesis Combinations" (APC) would be combinations that fall outside those in the OPC. In the AOANJRR, the lowest-risk TKR (featuring a cemented tibial implant; a minimally stabilized design; a fixed bearing, cross-linked polyethylene bearing surface; and patellar resurfacing) had a 60% decreased revision risk compared with the APC option (Fig. 2).

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Optimum Prosthesis Combination	31404	24327	18362	13736	10162	7202	5091	3651
Alternative Prosthesis Combination	450969	401004	352957	308323	265829	225646	188000	154417

Number at Risk	8 Yrs	9 Yrs	10 Yrs	11 Yrs	12 Yrs	13 Yrs	14 Yrs	15 Yrs
Optimum Prosthesis Combination	2514	1902	1430	864	412	128	0	0
Alternative Prosthesis Combination	123653	96558	72554	51550	34275	19958	8597	2040

02 Cumulative Percent Revision of Primary TKR by Prosthesis Combination in Patients with Osteoarthritis

The cumulative revision rates of the OPC cohort at 3 years (1.4%; 95% CI, 1.3% to 1.6%), 5 years (1.8; 95% CI, 1.7% to 2.0%), and 10 years (2.4%; 95% CI, 2.1% to 2.8%) represent a pragmatic tool that could be used to (1) improve collaborative quantitative and qualitative clinical decision-making by surgeons, patients, and health-care funders, and (2) reduce revision risk, improve patient outcomes, and reduce costs through the identification of low-risk TKR options. Furthermore, the cost to the health system associated with maintaining the current large number of primary TKR options is multiplied further when the separate factor of prosthesis manufacturer is considered.

An important consideration related to clinical decision-making is the recognition that there will be some outcome variability depending on the manufacturer of the components. Unique attributes such as tibiofemoral morphology, cross-linked polyethylene manufacturing, and femoral cementless fixation surfaces cannot be regarded as interchangeable commodities, emphasizing the important role that registries have in monitoring the revision risk associated with individual prosthesis systems.

How to Implement Surgeon Preference Change?

Implementation research is the scientific study of methods to promote the uptake of research findings, and hence, to reduce inappropriate care. To implement clinical practice change, it is necessary to understand, identify, and overcome the barriers to change. Methods to overcome implementation barriers include gainsharing, stakeholder partnerships, specific clinician feedback, and interdisciplinary general reports. While the reporting, recognition, and acceptance of unnecessary surgeon preference-driven variation will translate into preference change, decreased costs, and better patient outcomes, the actual implementation of practice change can be more demanding on resources than obtaining the initial evidence. Specific clinician feedback has advantages of data ownership over nonspecific prosthesis reports as it incorporates all aspects of the clinician's practice, not just their preferred implant.

A fundamental caveat to concepts such as "developmental dead-ends" and "utilization-evidence incongruity" is the importance of new innovations in arthroplasty and their safe and controlled introduction. New innovations can improve patient outcomes; however, in recent years, many new implants or innovations have produced no better or worse outcomes following knee replacement. Nevertheless, future innovations may produce improved outcomes, and hence, robust and stepwise methods are required for their safe introduction[5].

In conclusion, what constitutes practice-changing evidence should be judiciously considered, with surgeons recognizing the intrinsic cognitive biases that can act as barriers to implementing prosthesis change, thereby creating an evidence-utilization incongruity and a resultant persistence of failed design innovations. A useful and pragmatic comparator of registry survivorship is a combination of the lowest-risk design options based on national data. On the basis of AOANJRR data, the lowest-risk TKR prosthesis is one with the following features: a cemented tibial implant; a minimally stabilized design; a fixed bearing, cross-linked polyethylene bearing surface; and patellar resurfacing.

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Management of Distal Clavicular Fractures

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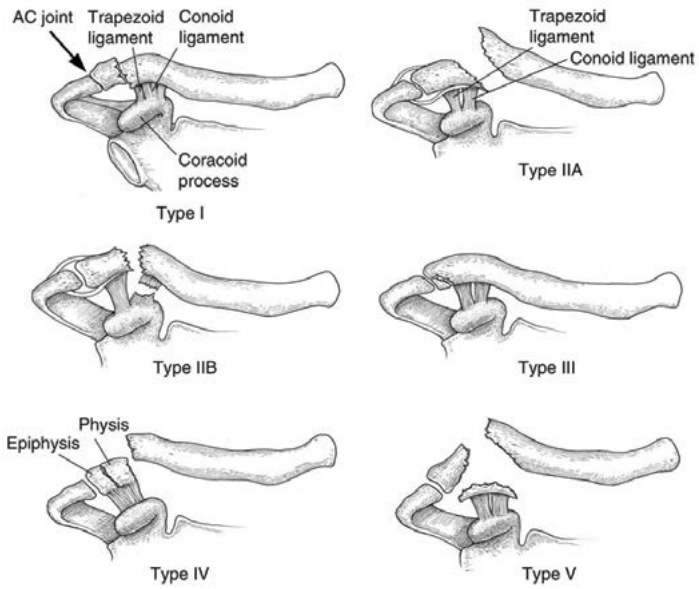
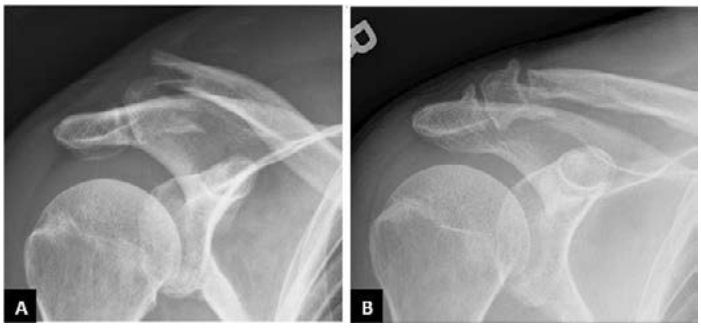
Introduction

While the clavicle is one of the most commonly fractured bones in the body, fractures of the distal part of the clavicle account for 2.6% to 4%[1] of all adult fractures and 10% to 30%[2] of all clavicular fractures. Distal clavicular fractures have a bimodal age distribution, with a first peak in active young adults and a second peak, usually due to falls, in elderly people. The most common classification system is the Neer system, in which Type-I is a nondisplaced fracture, Type-II is a fracture with disruption of the coracoclavicular (CC) ligaments, and Type-III is an intra-articular fracture (Fig. 1). Later additions to this system include Type-IV fractures, which are rare and in the pediatric population involve disruption of the periosteal sleeve, with the epiphysis and physis mostly maintaining their relationship to the shoulder joint. Type-V fractures involve avulsion of the CC ligaments along with a fragment of bone from the inferior portion of the clavicular shaft, with subsequent superior displacement of the distal part of the clavicle.



01 Modified Neer classification for distal clavicular fractures. (Reprinted with permission from: Banerjee R, Waterman B, Padalecki J, Robertson W. Management of distal clavicle fractures. J Am Acad Orthop Surg. 2011;19[7]:392-401.)

In both Type-I and Type-III fractures, the distal fragment is nondisplaced as the fracture is located distal to the CC ligaments; as such, these fractures typically heal with nonoperative treatment. In Type-II and Type-V fractures, the main controversy is related to the type of treatment (nonoperative versus operative). The main impetus for this controversy is the observation that nonoperative treatment of Type-II and Type-V fractures is associated with a nonunion rate of 33% (Fig. 2), whereas operative treatment is associated with a nonunion rate of only 6.7%[1,2]. Despite this difference, most studies have shown no significant difference in functional scores between patients managed nonoperatively and those managed operatively[1,2]. As a result, some surgeons advocate early operative intervention, whereas others note that, over time, patients who receive nonoperative treatment function just as well as those who receive operative intervention. In addition, among surgeons who recommend operative treatment, there is no agreement with regard to which surgical technique is most effective[1-4]. The aim of the current review is to summarize the advantages and disadvantages of various surgical techniques recommended in the literature for Type-II and Type-V distal clavicular fractures.



02A Radiograph showing a Type-II Neer distal clavicular fracture that was treated nonoperatively.
02B Radiograph, taken 5 months after trauma, showing nonunion.

Operative Treatment

The challenge of the operative treatment of distal clavicular fractures is reflected by the numerous surgical methods that have been described in the literature for the fixation of these injuries (Table I). The major issues associated with surgical treatment are (1) obtaining fixation when there is typically only a small distal fragment for fixation, (2) prevention of nonunion, (3) recurrence of the deformity, and (4) postoperative stiffness. The surgical techniques can be roughly divided into those that involve direct repair with use of hardware, techniques to stabilize the clavicle to the coracoid, and combinations of both. Surgical approaches also can be divided into open, arthroscopic, and combined techniques.

Table 1. Literature Review of Outcomes of Various Fixation Methods for Displaced Distal Clavicular Fractures*

Study	Treatment Method	No. of Patients	Mean Age *(yr)*	Mean Duration of Follow-up *(mo)*	Mean Functional Outcome Scores at Final Follow-up	No. of Patients with Nonunion	No. of Patients Requiring Revision Surgery for Nonunion	No. of Complications Other than Nonunion
Fann et al. (J Trauma, 2004)	Intramedullary (transacromial Knowles pin)	32	41	80	UCLA score, 25	0	0	AC arthritis (1)
Kwak et al. (J Orthop Trauma, 2017)	Multiple transacromial 2-mm pins (S-pins)	Total 56 (15 had additional interfragmentary screws for oblique fractures, 9 had bone-grafting)	45	31	Constant Score, 96; UCLA score, 33	0	0	Pin migration (14), AC arthritis (9)
Scadden et al. (Injury, 2005)	Intramedullary (extra-articular malleolar screw)	10	29	Range, 12-48	Oxford score, 21	0	0	0
Lee et al. (Int Orthop, 2009)	K-wire with tension band wiring	20	40	26	Constant score, 88; return to work at 3 months, 60%; return to pre-injury level of activity at 6 months, 40%	1	1	Infection (2), loss of reduction (3)
	Hook plate	32	26	26	Constant score, 90; return to work at 3 months, 94%; return to pre-injury level of activity at 6 months, 81%	0	0	Symptomatic hardware (17), plate displacement (1)
Rokito (Bull Hosp Jt Dis, 2002)	CC stabilization with sutures	14	36	60	Constant score, 88; ASES score, 83	0	0	0
Fazal et al. (Orthop Surg Hong Kong, 2007)	CC stabilization with screw	30	Range, 19-39	12	SST score, 11	0	0	CC ossification (3), screw back out (2)
Macheras et al. (Orthopedics, 2005)	CC stabilization with screw	15	27.2	16	ASES score, 97	0	0	0

Management of Distal Clavicular Fractures

Table 1. Literature Review of Outcomes of Various Fixation Methods for Displaced Distal Clavicular Fractures* (con.)

Study	Treatment Method	No. of Patients	Mean Age *(yr)*	Mean Duration of Follow-up *(mo)*	Mean Functional Outcome Scores at Final Follow-up	No. of Patients with Nonunion	No. of Patients Requiring Revision Surgery for Nonunion	No. of Complications Other than Nonunion
Yamaguchi et al. (Int Orthop, 1998)	CC stabilization with screw	11	40	68	All patients returned to work and sports activity	0	0	0
Mall et al. (J Orthop Sci, 2002)	CC stabilization with polydioxanone suture (PDS)	12	Range, 21-47	29	Constant score, excellent	1	—	4 (disengaged from clavicle [1], unhooked from acromion [1], clavicular fracture [1], wound breakdown [1])
Haider et al. (J Shoulder Elbow Surg, 2006)	Hook plate	22	43	41	Constant score, 94; DASH score, 5	—	0	0
Renger et al. (J Orthop Trauma, 2009)	Hook plate	44	38	27	Constant score, 92	2	1	37 (impingements [33], infections [2], acromial hole widening [3], hypertrophic scar [2])
Kalamrasa et al. (J Shoulder Elbow Surg, 2008)	Interfragmentary locking plate	9	31	14	Constant score, 96	0	0	1 infection
Sautet P et al. (Orthop Traumatol Surg Res, 2018)	CC stabilization with endobutton	14	35	20	Constant score, 91	0	0	Implant irritation (4 [2 required removal])
Mochizuki et al. (Arch Orthop Trauma Surg, 2019)	Arthroscopic CC reconstruction with synthetic graft and K-wire	23	34	18.6	Quick DASH score, 3.8; ASES score, 92; Constant score, 94	0	0	0
Yagnik et al. (Orthop J Sports Med, 2019)	CC stabilization with cortical button and reconstruction with semitendinosus allograft	21			ASES score, 88; UCLA score, 33	0	0	Hardware irritation (1), adhesive capsulitis (1), wound dehiscence (1)
Xu et al. (BMC Musculoskelet Disord, 2019)	Interfragmentary locking plate with CC stabilization	18	46	17.5	Constant score, 93	0	0	Implant-related pain/discomfort with movement (2)
	Interfragmentary locking plate without CC stabilization	16	51	16	Constant score, 88	0	0	Plate failure from distal clavicle (1), implant related pain/discomfort with movement (2)

Study	Treatment Method	No. of Patients	Mean Age *(yr)*	Mean Duration of Follow-up *(mo)*	Mean Functional Outcome Scores at Final Follow-up	No. of Patients with Nonunion	No. of Patients Requiring Revision Surgery for Nonunion	No. of Complications Other than Nonunion
Flinkkila et al. (Eur J Orthop Surg Traumatol, 2015)	Arthroscopic TightRope	21	39	32	Constant score, 93	1	0	Implant failure on clavicular side, revised (1), deep infection (1)
	Hook plate	19	45	62	Constant score, 89	1	0	Frozen shoulder (1), deep infection (1)
Hsu et al. (J Shoulder Elbow Surg, 2018)	Cow-hitch CC loop with Mersilene tape	23	42	14	Constant score, 95	3 (13%)	0	0
	Hook plate	49	48	13	Constant score, 87	4 (8%)	0	12 (24.5%) (AC arthritis [5], rotator cuff tear [2], peri-implant fracture [3], loss of reduction [1], had implant malpositioning [1])
Singh et al. (Orthop Traumatol Surg Res, 2019)	Hook plate	16	37	Median, 11	—	Not evaluated as patients with nonunion were excluded from study		10 (63%) (hardware irritation requiring plate removal)
	Interfragmentary locking plate	37	16		—			6 (16%) (hardware irritation requiring plate removal)
	CC stabilization with sutures	21	21		—			Adhesive capsulitis (3)

*CC = coracoclavicular; AC = acromioclavicular; ASES = American Shoulder and Elbow Surgeons; UCLA =University of California Los Angeles; DASH = Disabilities of the Arm, Shoulder and Hand; TBW = tension band wire; SST = Simple Shoulder Test

Management of Distal Clavicular Fractures

The earliest operative technique to treat Type-II and Type-V injuries was to place pins or Kwires laterally through the skin, the acromion, the distal fragment, and the clavicular shaft. While inexpensive and relatively easy to perform, this technique can be plagued by pin breakage and migration of the pins to various sites, including the cervical spine, trachea, lung, vascular structures, and even the abdomen[2]. The use of Knowles pins or additional tension band wiring with K-wires and intramedullary screw fixation may decrease the rate of complications associated with this technique. More rigid fixation can be obtained with use of interfragmentary fixation with locking plates (either one plate or two plates oriented 90° to each other). Unfortunately, fixation into the distal fragment can be tenuous and failure may occur, especially if the bone is soft[3]. Augmenting the plate with sutures around the coracoid and clavicle can help to prevent failure until the fracture heals. Hook plates have been reported to be effective for the treatment of distal clavicular fractures, but that technique requires removal of the plate; if the plate is not removed, erosion of the acromion and rotator cuff symptoms can occur[3].

Other promising techniques involve reconstruction of the CC ligaments with devices that secure the clavicle down to the coracoid, essentially replacing the CC ligaments. The options in the literature have included the use of a CC screw alone, polydioxanone (PDS) sutures, Dacron graft, Mersilene tape, Ethibond sutures with a button, and suture anchors.

Results and Complications

The results of various techniques can be evaluated on the basis of patient-reported outcomes and return to work or sports. In terms of patient-reported outcomes, previous studies have demonstrated good to excellent results with no difference between K-wires, tension band wiring, hook plates, interfragmentary locking plates, and CC stabilization[2,3]. Another consideration when treating Type-II and Type-V distal clavicular fractures is the effect of the surgical technique on return to work, sports, and other activities. In one study, hook plates demonstrated a higher rate of return to work at 3 months (94% vs. 60%) and a higher rate of return to the preinjury level of activity at 6 months (81% vs. 40%) as compared with K-wires with tension band wiring[2] (Table I). Zhang et al., in a systematic review of 22 studies, reported that locking plate fixation had a higher rate of return to work at 3 months postoperatively as compared with hook plates (94.4% vs. 73.3%)[4].

One of the most common complications associated with any of these surgical techniques is failure of fixation and subsequent nonunion. The complication rates reported for operative treatment reveal that some techniques are preferable to others.

Oh et al.[1], in a systematic review, found that the complication rate was 41% for hook plates, 20% for K-wires with tension band wiring, 6.3% for locking plates, 2.4% for transacromial intramedullary screws, and 4.8% for CC ligament reconstruction with various materials. The complication rate associated with nonoperative treatment has been reported to be as low as 6.7%, so this should be considered when the options are being discussed with the patient. The systematic review by Zhang et al., also indicated that locking plate fixation had lower rates of complication in comparison with hook plates (5.6% vs. 23.3%)[4]. Asadollahi and Bucknill, in a meta-analysis of 11 studies, reported that the rate of complications associated with hook plates was 3.2 times lower than that for K-wires with tension band wiring, 3.7 times higher than that for CC stabilization, and 5.2 times higher than that for interfragmentary locking plates[3]. In summary, the available literature seems to indicate that interfragmentary locking plate and CC stabilization may be preferred methods of distal clavicular fracture fixation because those methods are associated with lower complication rates.

Open vs. Arthroscopic Techniques

The published studies of arthroscopic techniques for the treatment of distal clavicular fractures have shown high union rates with few complications (Table I). Banerjee et al., in a review article, reported promising results in association with arthroscopic treatment of distal clavicular fractures with use of CC stabilization with a double-button device and sutures[2]. Flinkkilä et al., in a study in which arthroscopic CC stabilization with use of TightRope was compared with hook plate fixation, found similar patient-reported outcomes between the two groups[5]. However, arterial injury has been observed in association with arthroscopic treatment of this type of injury, so the proximity of the neurovascular bundle should be considered when performing surgery in this area.

Summary

In summary, the decision to treat Neer Type-II and Type-V distal clavicular fractures should be individualized after adequate counseling of the patient regarding the outcomes of nonoperative and operative treatment and complications related to various methods of fixation. Interfragmentary locking plate and CC stabilization may be preferred methods for the operative treatment of distal clavicular fractures because those methods are associated with lower rates of complications.

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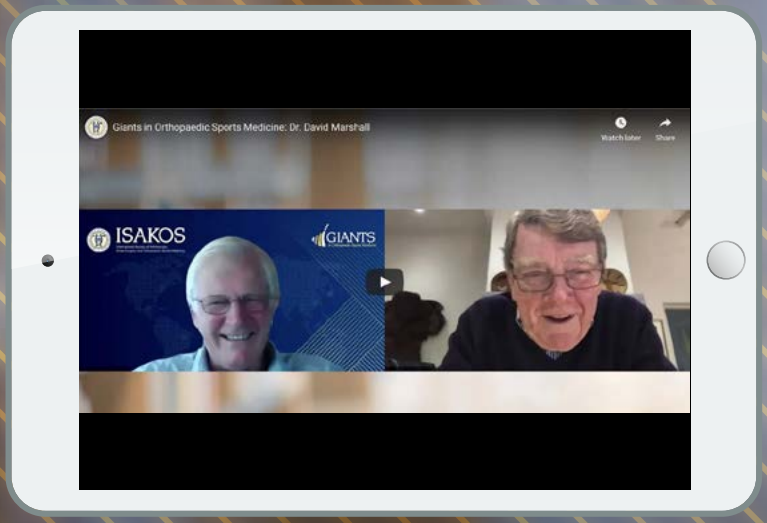

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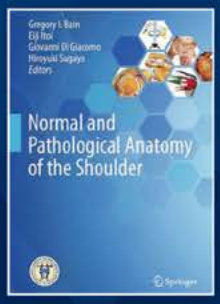

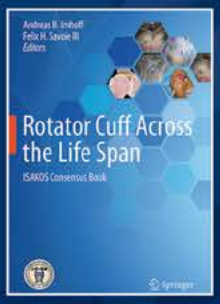

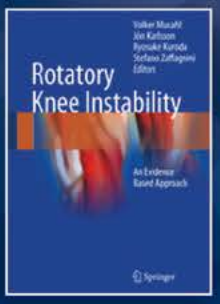

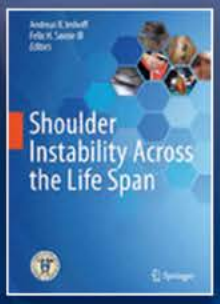

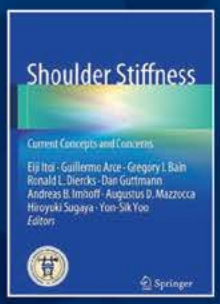

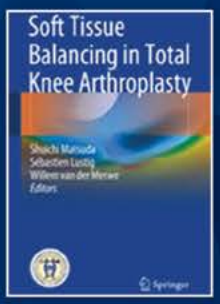

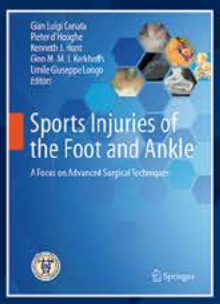

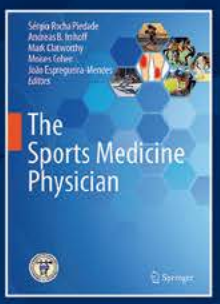

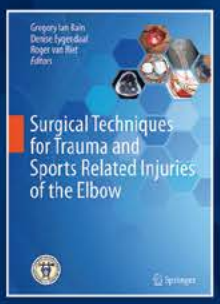

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