Dear Colleagues, Dear EFOST Family,

After a wonderful organized meeting in London, our Newsletter is on the web with your valuable contributions. 7th EFOST Meeting which was combined with World Sports Trauma Congress was one of the best and highly participated organizations in our short history. Programme and Organising Committees; especially to EFOST immediate Past-President Dr. Kelberine, BOSTAA President Dr. Hackney and all EFOST past-presidents, deserved special thanks for their intense effort they show for preparing a perfect meeting in an amazing athmosphere.

I don’t want to be wordy and let you to read first messages of new President Dear Maffulli. I know that he will accomplish this duty with his interminable energy. My last words are about an announcement of the partnership with OrthoEvidence. With this collaboration all EFOST members will have opportunity for free access to an expanding database of over 1000 Advanced Clinical Evidence (ACE) reports on a variety of specialty areas in orthopaedics and exclusive audio and video interviews from authors. We encourage you to discover this partnership with more advantages for EFOST Members. To start using OrthoEvidence just visit the link; http://myorthoevidence.com/2012/newsletter/N9174657115137.html

Prof. Mahmut Nedim DORAL, M.D.
EDITORS NOTE

Gideon MANN, M.D.
Editor

The Winter 2013 Issue of our Newsletter is now on the web. This has again been designed to allow our members an insight to EFOST, to provide information on upcoming meetings and events, to spread the knowledge on available courses and fellowships and to access updated scientific information and reviews of current literature abstracts.

We wish to eventually launch a section on "Tips and Pearls" from our members.

Could we possibly encourage you, our faithful members, to send in interesting material of your own: Interesting arthroscopic or surgical pictures, surgical tips you use, an interesting case you have encountered or a solution you have discovered when a problem came up, so that others may benefit from knowing it.

We, the EFOST Board and Newsletter Editorial, wish you a beautiful, peaceful and productive year of 2013.

Prof. Gideon Mann, M.D.

Meir University Hospital Medical Center
Department of Orthopaedic Surgery
Service of Sports Injuries

© 2013 EFOST
www.efost.org
PRESIDENT’S MESSAGE

Nicola MAFFULLI, M.D. PhD
President

It has happened, and it will stay with us forever. From 17 to 20 October, London hosted the 2012 World Sports Trauma Congress and the 7th EFOST Congress. The Queen Elizabeth II Congress Centre saw more than 600 attendees crossing its threshold to immerse themselves in four days of the highest level of education in our specialty. It did not happen by change. It started the moment that London was assigned the Olympic Games, in 2005. At that stage, we knew that the World Sports Trauma Congress would have been in the Olympic town, and it was just an issue of where and when. Mr Roger Hackney took up the Presidency of BOSTA, the British Orthopaedic Sport Trauma Association, in 2008, and the Organising Committee was formed. It was only logical that EFOST would have lent its hand, and supported the Congress with its own Congress. At the initial stage, tentative approaches. When Francois Kelberine became the President of EFOST, the pace intensified. A major move was to ask GCO to professionally manage our congress activities and to inject more professionalism to the running of the organisation. There have been too many teleconferences to count, and a myriad of face to face meetings: the names of Mike Carmont, Fares Haddad, Amanda Rees, Simon Roberts, Panos Thomas will always stay with us for the hard and unique work they put in selecting the venue, communicating with all of us, setting the programme, and adapting to the ever changing requests coming from all parts.

Towards the last few months, the usual panic that attendance would have been poor. The global economic outlook did not bide well, and at some stage we were afraid that, despite the quality of the programme and the intelligent advertising and marketing, we would have been very few. Fear not: the closer we got to the date, the more we were going to be. An indisputable success. Sisters organisations supported us: we are grateful to the whole of the presidential line of the AOSSM, the American Orthopaedic Society for Sports Medicine, to have participated and offered their advice. ESSKA, with both President and Past President
paid a most welcome visit, and our Asian counterpart sent its representatives. EFSMA and ECOSEP catered for the Sports Physicians, and we had a world wide partner with ISAKOS. Participants came from really everywhere: China, South America, Australia. The Specialist Societies affiliated to the British Orthopaedic Association gave superb support, and the scientific level of all these partners was unique: to all of them my personal thanks.

Roger Hackney and Francois Kelberine, the Presidents of the Congress, should be satisfied: the atmosphere was great, the quality superb, the opportunities to meet colleagues and exchange ideas unique. To them, my thanks.

On the fun side of things, the Thursday evening was spent at Fire and Stone, a stylish pizzeria in Covent Garden. A relaxed atmosphere, where we all got together and were treated to the magic imparted by a great close up magician, Josh, who was able to perform different tricks per each table he visited, leaving everybody enchanted.

On Saturday, I became the President: my acceptance speech will be on our Newsletter, which stays firm in the hands of Drs Mahmut Doral and Gideon Mann. A real creature of love, the Newsletter continues to allow EFOST to communicate with the whole membership, and ensure that we are all talking from the same hymn sheet.

Both Drs Doral and Mann decided to leave the Executive Board: to them, EFOST and my thanks. Their advice and wisdom will be required for years to come. We have now a Board of Trustee which shall work with the Executive Board to keep us on track, and help us all advance.

A President risks being and feeling lonely. I am lucky: our Past President, Francois, and our Vice President, Gernot Felmet, will help me out, and keep me out of trouble, and will have to suffer me. Also, Jose Huylebrook will offer precious advice.

EFOST is now leaving its adolescent phase, and is getting ready to enter the first phase of its youth. There will be problems, obstacles, complications. We are ready, with you, to face them, and to tackle and solve them as they present: not everything can be anticipated. One thing we anticipated is that a scientific association cannot have credibility without a journal. In 2011, Muscles, Ligaments and Tendons Journal (MLTJ), the official journal of EFOST and ISMuLT, the Italian Society of Muscles, Ligaments and Tendons, was started. I shall continue as its Editor in Chief: the first two years have been hard, and only now we are starting to see the evidence of the hard work of my Associate Editor, Dr Francesco Oliva. The future of MLTJ will depend on the high quality work that it publishes. As the President of EFOST and as the Editor in Chief of MLTJ, I prompt you to send us high quality manuscripts to
shall then really have worldwide appeal.

In the meanwhile, I look forward to work with the National Societies which have recently come into EFOST: they are our new blood, and our future.

Nicola Maffulli M.D.

EFOST President
The WSTC 2012 held in the QE2 centre London in October 17-20th attracted over 700 registrants from around the world. The meeting ran over 4 days with 2 parallel sessions covering all aspects of sports trauma. The co-organisers BOSTAA and EFOST were delighted to have many international and regional sports trauma associations support the meeting and organize and run sessions. From the UK, the Faculty of Sports and Exercise Medicine and specialist societies from the BOA also contributed and we would like to express our thanks to BOFAS, BASK, BESS and the BHS together with superb sessions organized by James Calder, Tim Spalding, Rohit Kulkarni, and Mike Hayton.

UK delegates comprised about 30% of attendees, with the majority from continental Europe, but with the Americas, Far East and Antipodes also represented.

Academically the meeting was of a very high standard. Speakers were allocated short presentations and although I was initially a little sceptical as to how this would work, it proved to be a very effective as speakers concentrated on the key take-home messages rather than excessive background, with repetition and duplication between speakers. I would recommend this format to meeting organizers in the future. The session chairs were firm in regard to time keeping and presented challenging questions for the speakers.

From my personal point of view, the shoulder and upper limb sessions dealt with controversies with fantastic input from the faculty and experienced audience. A great deal of informed debate followed during question and answer sessions. I am reliably informed that the parallel sessions were equally stimulating.

The quality of the original paper presentations was excellent and reflected the enormous interest in sports trauma research from all over the world.

Both BOSTAA and EFOST have been overwhelmed with positive feedback from delegates and invited speakers complimenting everything from the superb venue to the academic standard to the very convivial faculty dinner.
We would like to thank the trade for their tremendous support, in particular our Platinum sponsors Smith and Nephew, with Gold sponsors DJO and silver sponsors Arthrex.

This was an enormous effort for an organization of the size of BOSTAA/EFOST and a lot of time and effort was put in by the executive whom I would like to thank, and in particular Mike Carmont who has succeeded me as BOSTAA President. Francois Kelberine, EFOST President was equally hard working liaising with his European and transatlantic connections. Prof Nicola Maffulli succeeds him as President of EFOST and under his leadership European sports trauma and team physician care will continue to flourish.

Future BOSTAA activities include the continued Sports Surgery education programme at the Royal College of Surgeons London organised by Panos Thomas, activities with the BOA, collaboration with the FSEM, BASEM and the ACPSM. The challenge of hosting ISAKOS in the near future also beckons. More information can be found at our website www.bostaa.ac.uk.

Congress Chairs
Dr. Roger Hackney (President of BOSTAA)
Dr. Francois Kelberine (President of EFOST)
FEEDBACK FROM
THE COMBINED 7th EFOST CONGRESS & 4th WSTC

With my friend Roger Hackney, I had the privilege to be co-president of this congress organized together by EFOST and BOSTAA.

All the lectures, debates and free papers focused on Orthopaedic Sport Medicine field were of very high scientific quality. And the feedback reported the attendees and lecturers coming from whole over the world did appreciate whatever was their sub-specialization.

This Congress allowed re-known experts to share their expertise (interestingly different depending the place they come from) with the participants in a friendly atmosphere.

And it was truly satisfying to notice the involvement of young orthopaedic surgeons and young physiotherapists bringing new blood and energy to our Society. As an example, have a look in this newsletter on the report on the travelling fellowship.

I would like also to point out the unique and increasing collaboration with the National Sport Traumatology Societies (EFOST roots) as well as the International Societies (ISAKOS, AOSSM, APKASS, ECOSEP, ESSKA). They ran their own session with key opinion leaders and the exchanges were very fruitful.

Of course, I thank our industrial Partners and the Organizing Committee (GCO) who helped us to make the London congress such a successful one. It has been a jump forward in the maturation of EFOST.

So I am sure you will attend the next 8th EFOST meeting in Lisbon Portugal, September 2014, 24th-26th. Save now the dates in your diary!

EFOSTLY yours
Dear EFOST Family, Dear Colleagues,

7th EFOST Congress & World Sports Trauma Congress was held in Queen Elizabeth II Conference Center, London at 17-20 October 2012.

The program was consisted of high standard -a high-quality scientific programme presenting the latest research and studies in the field, a prominent and renowned faculty gathering worldwide speakers, a well-designed and attractive trade exhibition, a promising scientific exhibition and poster presentations- sessions from experts on their fields.

Many related societies and partnering associations like, ISAKOS, BHS, BOFAS, EFSMA, ICRS, FORTE, ESSKA, UEFA, AOSSM, BASK, SIGASCOT, BESS, APKASS, FSEM, SETRADE, ECOSEP was contributed to the educational programme with their sophisticated lectures.

Geoff Parsons, John Bergfeld, Dominic O’Dowd, Norimasa Nakamura were the guest lecturers of the congress. Past travelling fellows (Jonathan Bravham, Robert Magnussen, Guiseppe Longo and Rocco Papalia) participated the sessions with lectures about their experiences during the fellowship process.

During the congress some presentations were awarded as;

*** BEST ORAL PRESENTATION (Prize supported by Arthrex): Dr. Khay-Yong Saw (Malaysia) Articular Cartilage Regeneration with Autologous Peripheral Blood Stem Cells: A Randomized Controlled Trial

*** BEST POSTER (prize supported by BOSTAA and EFOST): Dr. Harry Benjamin-Laing (UK) Successful return to play in athletes following non-operative management of acute isolated posterior cruciate ligament injuries
*** BEST YOUNG PRESENTER (Prize supported by Medi) Dr. Robert Magnussen (USA)
The influence of graft size and femoral tunnel drilling technique on outcomes of ACL reconstruction

See you in Portugal for 8th EFOST Congress in 2014...

SOME FACTS & FIGURES

ATTENDANCE PROFILE

- 701 attendees (%69 were orthopaedic surgeons, %25 were trainees and residents)
- Worldwide representation (%80 Europe, %5 North America, %5 Asia, %4 Africa)
- TOP 3 European countries represented (%41 UK, %7 Spain, %7 Italy)

SCIENTIFIC HIGHLIGHTS

- Scientific Sessions
  - 42 sessions over 4 full days
  - 2430 minutes for share of knowledge, research, trends and best practices
  - 137 faculty members

- Free Papers
  - 232 free papers submitted
  - %35 were considered as having an extremely high scientific merit
  - 117 posters (%31 knee, %13 foot&ankle, %12 hip)
  - 13 oral presentation sessions including 62 presentations (%21 knee, %13 engineering in sports medicine, %12 hip)

- Industry
  - 800 sqm of exhibition space
  - 16 exhibiting companies
  - 4 Congress sponsors (Platinum sponsor: Smith & Nephew, Gold Sponsor: Stryker, Silver Sponsors: Arthrex UK, DJO Global)
  - 4 Lunch-time workshops
From prevention to recovery, DJO Global enables people to live their lives to the fullest by providing intelligent medical devices and services.
Team Physician Traveling Fellowship from the USA to Europe

October 2012, 3rd-20th

by

Jonathan T. Bravman

Assistant Professor, Division of Sports Medicine and Shoulder Surgery, Department of Orthopedics, University of Colorado; Denver, CO

Robert A. Magnussen

Assistant Professor, Department of Orthopaedics, The Ohio State University College of Medicine, Columbus, OH

Portugal

The EFOST traveling fellowship began with a visit to Lisbon, Portugal, where we were hosted by Henrique Jones. After a long flight (fortunately featuring lay-flat seats!), we checked into our hotel in Lisbon and were ready to get started. After a quick (3 course) lunch, we were off to the operating room where Dr. Jones demonstrated his ACL reconstruction technique as well as a total knee arthroplasty in a younger, active patient with a ceramic femoral implant, assisted by his two residents. After the OR, we were treated to an excellent seafood dinner with his team.

After a good night of sleep, we began the next day with a trip to the Benfica Football (Soccer) Club training center. It was interesting for us to see the huge campus and understand a bit more about how football clubs develop talent from a very young age all the way through the professional level. A highlight of the visit was a tour of the facilities with a focus on the injury prevention efforts undertaken by the medical and training staff. The amount of resources devoted to this task was impressive and demonstrates what can be achieved when there is significant buy-in to such a program.

After the visit, we had another delicious lunch overlooking the city of Lisbon from Cliffside restaurant and returned to downtown Lisbon for a tour of the Fisio Gaspar rehabilitation
injuries in professional football. After the tour, we travelled with Dr. Jones to his hometown of Setubal, which is located on the coast outside of Lisbon where we visited a beautiful castle with incredible views of the ocean and town. Then we made rounds with Dr. Jones on his patients at the local hospital. After a brief visit to Dr. Jones’ home hosted by his wife, Luisa, we were off to another delicious seafood dinner at a local restaurant (we did not starve in Portugal!)

The next morning featured an academic session at Dr. Jones’ clinic where we presented our research and heard interesting work regarding the use of PRP and shockwave therapy. We had a free afternoon to tour the city and managed to ride the subway around without incident.

Our last full day in Portugal included a tour of the old town of Lisbon, visits to an art gallery and the starting point of many Portuguese explorers as they ventured around Africa, as well as a tour of the area surrounding Lisbon. We visited the western-most point in Europe and sampled coffee and typical pastries in beautiful old towns in that region. The day finished with the Benfica football match where they pulled off a second half comeback to win 2-1. The next day we were off to Italy.
Italy

We arrived in Torino, Italy, in the late afternoon and were greeted with a beautiful view of the Alps from the plane and were picked up at the airport by Davide D'Elicio who took us to the city center where we had a nice dinner and met Gian Luigi Canata, EFOST secretary, who served as our host for the week.

The next morning, we visited the operating room at the Center of Sports Traumatology, Koelliker Hospital, where Dr. Canata performed three ACL reconstructions and we tried to empty the coffee machine just outside the operating suite (which proved impossible). We discussed different femoral tunnel drilling techniques as well as graft fixation methods and the differences between health systems in our countries. We then traveled to the CUS Torino athletic club where we had a tour of the facility and lunch hosted by the club's president, Riccardo D'Elicio. The facility provides fitness opportunities for students in Torino and fields teams in numerous sports at all levels, from beginning dance classes to first division rugby. That afternoon, we toured the historic downtown, including the royal palace. Because it was closed on Monday, they arranged a private tour for us, which was truly incredible. The busy day was finished off by working on our (terrible) golf swings at the CUS Torino driving range and a hearty meal featuring fine Italian wines.

The next morning featured a tour of the Instituto di Medicina dello Sport di Torino, which is housed in the Olympic stadium, followed by lunch and tour of a tennis club. The afternoon
included a tour of the Torino Cinema Museum including the breathtaking view from the top of its spire. We then returned to the Instituto di Medicina dello Sport di Torino for a scientific session where we presented our research and discussed graft choice for primary and revision ACL reconstruction as well as outcomes of hip arthroscopy. Following the session, we visited the CUS Torino rowing training facility and experienced a unique perspective of the city as we returned to the downtown area via the river. A final Italian meal awaited us there before our early morning flight to Germany.

Germany

We arrived in Stuttgart after an early morning flight and were greeted by Dr. Felmet’s assistant, Almera who drove us south to Villingen-Schwenningen where we first stopped off to meet with the Wilde Wings professional hockey team and had a chance to tour their facilities and meet with their manager and medical personnel. We quickly checked into our hotel, the Waldeck spa and wellness center, where it so happens that Dr. Felmet’s patients stay to recover after surgery. We then drove to Artico Sportklinik to tour the office and OR and meet our gracious host, Gernot Felmet and his colleague, Frank Bomers of DJO Global. We had a nice local lunch with Frank, giving us an opportunity to thank him personally for DJO’s support of our trip. Thankfully we didn’t eat too much, as upon return to the office, we were greeted by Gabriella Settipani who took us through a novel vibration plate-training program that Dr. Felmet frequently employs with good results in his patients – it was certainly a challenge! The session was followed by mandatory espresso and a tour of the old town of Villingen, topped off by a fabulous meal at the Waldeck with Dr. Felmet.
We awoke the next morning and met Dr. Felmet in the lobby to begin AM rounds at the Waldeck where we saw several fresh post-operative ACL reconstruction patients and reviewed their typical post-operative course. We then drove the short distance to the Sportklinik for a morning OR session where Dr. Felmet demonstrated the details of his press-fit, implant-free hamstring autograft ACL reconstruction technique. This generated much stimulating discussion and is certainly a novel approach that both of us had heard of, though not seen first-hand. Given our slight skepticism, Dr. Felmet made a point to have us join him in clinic where we personally examined several patients that had been reconstructed with this technique – and I think any surgeon would be happy with the stability results he is getting with this technique! After a brief interview with a reporter from a local newspaper, we went to visit a local insurance company to meet with several executives who gave us an excellent insight into the DRG system and how health care is managed in Germany.

The afternoon left some time for a nice 10K run in the woods of the Black Forest with our enthusiastic student host, Sarah, which whetted our appetite for a delicious meal in Villingen accompanied by Dr. Felmet and his partner, Bettina. We were then hosted at Dr. Felmet’s home to enjoy some local wine and continue our conversation on ACL technique and fixation.

With no rest for the weary, we were up and at it early the next morning where we met with Markus Piro of Orthopädie und Vitalzentrum who is a master prosthetist. We were very
impressed with their facility, level of sophistication and in-house manufacturing of carbon fiber and various material prosthetics and orthotics for orthopaedic patients and were able to view gait analysis with ACL bracing. This was followed by a tour of the local saltwater spa and rehabilitation center, Solemar, a quick lunch, and transfer via autobahn with Dr. Felmet to Heidelberg for the live surgery Castle Meeting.

We arrived in time to catch the last session of the day at the Castle Meeting, certainly in the most majestic location either of us had ever been for an orthopaedic congress. We joined the faculty for drinks and an excellent traditional German dinner, where we were able to catch up with several old and new friends and meet our host of the next leg of our journey, Burt Klos. The next day was spent enjoying the fabulous talks and live surgical demonstrations at the Castle Meeting, an experience we unfortunately do not frequently have in the United States. Several stimulating and novel topics were presented, such as details of tunnel drilling and attachment of the native ACL as it pertains to reconstruction. We were then accompanied by Dr. Klos on the high-speed train to Amsterdam, The Netherlands.

The Netherlands

The train was a fantastic way to travel, complete with a nice space to catch up on some work and local draft beer to quench our thirst. This also gave us a nice opportunity to get to know Dr. Klos and to share ideas on a variety of topics. We were met by our co-host in Amsterdam, Bas Pijnenburg and brought to our hotel for a welcomed rest.
We awoke to a typical seasonal day in the Netherlands, which made for nice weather for a run with a slight rain. Armed with raincoats and umbrellas, we headed out to see the sights of Amsterdam. We toured the area with Dr. Klos, continuing our discussions, specifically on computer navigated ACL reconstruction and concluded our day with Drs. Pijnenburg and Klos at the famous Nam Kee Restaurant.

The next morning we were up early to enjoy the local park for a run, while watching the incredible amount of bicycle commuters on their way to work – and we now realize how Europeans remain so fit! We were met by the physician assistants working with Dr. Pijnenburg and had a visit with the gracious staff at Fysiomed, a therapy and rehabilitation center where many elite athletes are seen to help in recovery from injury and surgery. After scientific presentations there we drove to Ziekenhuis Amstelland hospital for an intriguing scientific session focused on both a live demonstration of dynamic ultrasound for meniscal and ACL pathology as well as a demonstration on the technique of computer navigated ACL reconstruction – which we all agree may indeed have a role in detecting subtle rotational instability in certain patients. An excellent local dinner was followed by travel back to Amsterdam to observe a world class Boksgala (Boxing match) where Dr. Pijnenburg served as the ring physician. We had the best seats in the house with the privilege of sitting in the Queen’s reserved box seats! The match stimulated excellent discussion on brain injury and concussion, especially given the focus of our national society recently.

We were greeted the next morning by Dr. Klos’ father, who graciously drove us south to Rotterdam, where we were hosted by Duncan Meuffels at Erasmus Medical Center. We toured their extensive research facilities, had the opportunity to meet with several post-doctoral fellows and participated in a research symposium, where we presented our work.
the famous EuroMast and a brief walking tour of Rotterdam, we were off to the airport for the last leg of our journey: London, England to attend the 7th bi annual EFOST Congress combined with the 4th World Sports Trauma Congress in the post-Olympic city.

**England**

We were greeted in London by our host and incoming EFOST President, Nicola Maffulli and his current fellow and brought to our hotel in sight of the lovely Green Park. After a traditional pub-style dinner we got some rest in preparation for a busy few days of the combined 7th EFOST Congress and WSTC Congress. We were both privileged to be invited as faculty to present our work at the meeting. We greatly enjoyed the faculty dinner where we had the opportunity to reconnect with our new friends that had hosted us in the previous weeks and the current President of EFOST, Francois Kelberine, as well as meet many new friends and colleagues. We took full advantage of the meeting and the wonderful city of London, including a Jack the Ripper tour of East London and several runs through beautiful Hyde Park. We both had a nice trip back the States, thankfully not too far behind in catching up with work waiting for us at home!

We are so very grateful and appreciative of the experience we were able to take part in with this travelling fellowship. We would like to specifically thank Francois Kelberine, EFOST, our gracious hosts, DJO global, our departments and partners for supporting our practices while we were gone, and above all our families for supporting our endeavors. We have had the experience of a lifetime and look forward to continuing these relationships in the years to come.
The Official Journal of European Federation of National Associations of Orthopaedic Sports Traumatology (EFOST) and of the Italian Society of Muscles, Ligaments and Tendons (I.S.Mu.L.T)

MLTJ (http://www.mltj.org/) is an international open access quarterly peer reviewed journal, published in English. (Editor in Chief: Nicola Maffulli)
ARTICLE

PRE-PARTICIPATION EXAMINATION (PPE): INTEGRATING ELECTROCARDIOGRAM UNDER STRESS AS PART OF THE EXAMINATION OF SPORTSMEN

Gideon Mann¹,²,³, Gal Dubnov-Raz⁴, Atzmon Tsur⁵, Ron Golan²,⁶, Peter Jenoure⁷

¹ Department of Orthopaedics, Meir Medical Center, Kfar Saba, Israel
² Ribstein Center for Research and Sports Medicine Sciences, Wingate Institute, Natanya, Israel
³ Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel
⁴ Exercise, Nutrition and Lifestyle Clinic, The Edmond and Lily Safra Children's Hospital, Sheba Medical Center, Tel Hashomer, Israel
⁵ Rehabilitation Department, Western Galilee Hospital, Nahariya, Israel
⁶ Zefat Academic College, Zefat, Israel.
⁷ Sports Medicine Department, ARS Medica Clinic, ARS Ortopedica, Lugano-Gravesano, Switzerland

Introduction:

The Pre-Participation Examination (PPE) is an examination aimed to allow sportsmen to enter training and competition in the best of health, enabling them to achieve maximum achievements and preventing, as far as possible, illness, injury, disability or death (17,37). The PPE should be a holistic examination used to detect disease but also to disclose past injuries leaving disabilities (recurrent ankle sprains, knee or shoulder instability), deficiencies or limitations (CBC, Ferritin, eye sight, EIA or other) and correct them to the advantage of the sportsman. The PPE should also expose the young athlete to the physician allowing discussion of general health issues, otherwise not discussed and not acknowledged, like heat, cold, nutrition & fluid intake, or gender differences & sexual behavior (24). It is also a privileged moment to strengthen the trust between athlete and team doctor, as also to establish a very efficient longitudinal relation (33).
The cardiological side of the PPE, though dramatic, is only one part of the holistic PPE, while many advantages could be gained with minor investment and far higher cost effectiveness by emphasizing other fields. These reflections, though, are, in general, out of the scope of the following discussion.

This paper discusses the importance of preserving the stress test, through selective and controlled performance, as part of the pre-season participation examination, on a selection of athletes whose training or competition involve medium or high dynamic and static stress.

**ECG at rest as part of the PPE:**

Prior to introducing the discussion on stress testing, a few words should be said on the ECG at rest, following the review by Corrado et al, published in April 2011 (published online on January 29, 2011) (1). Despite the fact that this is not the main topic of discussion, we believe that we must say a few words about this issue.

Quoting the article of Roy Shephard, published in May 2011 (2), which discusses, amongst others, Baggish’s article of 2010 (3), the document of the Israel Heart Society presented to the Israel Ministry of Health on June 19, 2011 presents the opinion of Prof. Shephard that in North America, within the correct budgetary constraints for this part of the world, it is doubtful whether an ECG at rest is justified. The argument in this regard does not deal in particular with the value of the examination in identifying life-threatening cardiac conditions, but with the practical (requires additional investigations) and psychological price and rate of false positive examinations.

It should be emphasized that being precise with correct rules of ECG interpretation, as delineated in the European Heart Journal 2010 (15) should lower false positive reading rates to a possible minimum. The need for guidance and learning of correct ECG reading has been repeatedly emphasized in the article by Hill et al., 2011 (23), in regard to children and adolescents. The automatic deciphering facility in the in-built software in the electrocardiogram machine will decrease errors in deciphering even more, mainly in children where proficiency in normal variation is not always sufficient (23, 27).
Slightly different from the accepted, it seems that a family history of sudden death at a young age in first or second degree relatives lacks any value in its own right to detect a similar event in athletes (28). Borjesson & Dellborg, in a review published in January 2011 (19), came out strongly against omitting ECGs at rest from the seasonal examination. The authors vehemently claim that a cardiac examination without an ECG is only slightly more valuable than a total avoidance of a seasonal examination, whose actual cost without an electrocardiogram is significantly higher, for purposes of locating a single pathological case, than performing an examination that includes an electrocardiogram at rest. The authors also claim that the need for an electrocardiogram is anchored in the need to prevent, as much as possible, sudden cardiac death in athletes, while this has both ethical implications and is connected to the employer-employee relationship between the sports club and the athlete.

A review of the data shows that Baggish (3), in a group of 510 college athletes, compared the detection rate of life-threatening cardiac conditions through medical history and physical examination vs. history, examination and electrocardiogram. Five were disqualified from the first group and 11 from the second. The presence of a finding was verified with an echo, which is still the “golden standard” for diagnosing hypertrophic cardiomyopathy (HCM) (3, 4). In other words, performing an electrocardiogram doubled the detection rate. This number is low when considering the accepted data that history and physical examination are of lesser value (4, 19, 28) and will detect, as displayed by Maron in 2007, less than 10% of the cases at risk (5), or 3.7% as shown by Sofi et al. in 2008 (6). In a previous publication in 1996, Maron (20) displayed the detection of one case only out of 115 athletes, who underwent pre-season examination, including medical history and a physical examination only. Other publications from Italy (21) and England (22) also raised very low percentages of illness detection, while using a similar approach. The low detection ability of questionnaire and a physical examination are also mentioned by Pugh et al. in a review summarizing the position of the American Heart Association (AHA) and the European Society of Cardiology (ESC) in July 2012 (40). This problematic point is once again emphasized in the review on sudden death in children, published by the American Academy of Pediatrics in March 2012 (41).
The Price of Examinations and the Cost of Saving a Life:

The price of an examination in the USA according to the calculation of the Center of Medicare Services is $104 per stress test and $431 for an eco test (23). These amounts are very high in comparison to the prices in Israel for example. Prices of examination and life-saving costs have been discussed in detail in Wheeler’s article (18) in 2010, which summarized that considering the real incidence of death amongst youngsters during physical examination which might reach 1:9,000 (!) (11, 12), the cost of saving one athlete’s life in North America is comparatively not high, and definitely justifies the performance of an electrocardiogram at rest as part of the pre-participation examination in this continent as well. Marijon et al. reviewed in 2011 the death rates of athletes in the general population (29) amongst all athletes, which also includes older and amateur athletes. The rate of sudden death reached 4.6 million a year, while it was registered that 9.2 million were men and 9.8 million were competing athletes, i.e. 1:5,000 over 20 years of a person’s life as an athlete (29). In this regard it must be emphasized that the presence of hypertrophic cardiomyopathy (HCM) is expected to reach 0.2% in athletes (4) and the correlation of data from several articles shows that the presence of a life-threatening cardiac finding in athletes is expected to be 0.2% to 0.7%, or in close to 0.5% of athletes (1). Rizzo et al. (38) identified structural damage to the heart in 1.8% of 55 soccer players and suggested the regular use of eco tests in this population. The eco test as an identifier of hypertrophic cardiomyopath (HCM), Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC) and a widening of the Aortic vascular ring in Marfan’s Syndrome was also mentioned in the article written later by Pugh et al in July 2012 (40).

The addition of the electrocardiogram at rest to the pre-season examination program in Italy lowered the occurrence of deaths in athletes by 89%, from 3.6 per 100,000 person years to 0.4 per 100,000 person years (7).

The article by Steinvil et al. (8), published in 2011 on the basis of tests conducted in Israel (including a stress test), compared the two years prior to the imposing of compulsory tests in 1997 to the following years, and displayed a decline in the death rate from 8.4 deaths per 100,000 person years to 1.1 per 100,00 person years. This number changes, of course, if death rates for years prior to 1995 are
included, when the data was difficult to collect and not readily available, over and above the very different nature of athletes’ training at that time.

**The Importance of the Stress Test:**

On October 27-29, 2011 the biennial meeting of the European Federation of Sports Medicine Associations (EFSMA) was held in Salzburg, Austria. On October 29 a session dealing with Pre-Participation Examination (PPE) was opened by Prof. Fabio Pigozzi, a cardiologist and sports doctor, who is also Honorary President of the European Federation of Sports Medicine and the actual President of the International Federation of Sports Medicine (FIMS). Prof. Pigozzi, a full-time professor of sports medicine, serves as the deputy manager of the unit for sports medicine at the Rome University Institute of Movement Sciences. Prof. Pigozzi presented that which is performed in Italy and what is expected to develop in Europe. At the end of his lecture Prof. Pigozzi was asked: Is it true that sudden death is caused, as a rule, from arrhythmia? Is it true that arrhythmia occurs in cases of hyperthermia, hypokalemia or electrolyte imbalance? Is it true that these conditions are caused by physical exercise? Therefore, do you agree that a stress test is recommended in order to locate sportsmen at risk?

Prof. Pigozzi responded in the affirmative to all four questions and referred a question to the audience, where around 200 doctors specializing in this field were sitting: Does anyone in this audience disagree with what has just been said here? Not one person raised their hand.

In this regard it must be mentioned that hyperthermia, hypokalemia, an electrolyte imbalance, over-secretion of catecholamines and sympathetic activity will all be caused under stress, and initiate over-sensitivity of the heart muscle, as detailed by Thompson et al. in 2007 (34, 35). Pugh et al., in their article of July 2012, mentioned the hypotensive reaction under stress in HCM patients, arrhythmia under stress in non-atherosclerotic coronary patients, and the ventricular tachycardia under stress, which will be detected in a stress test following a rise in catecholamins (40). Though this data seemingly warrants using a stress test as part of the PPE, the authors do not recommend this in the summary of their paper.
Rizzo et al. (38) pointed to the fact that 1.8% of athletes will display an anomaly that could cause arrhythmia, and which would not be detected by the family history, by physical examination or by an electrocardiogram at rest. The authors suggested adding an echo test in sportsmen. Another article (39) mentioned the echo as also the stress test as part of an advanced investigation in sportsmen. This test is mentioned in regard to HCM, ARVC and widening of the Aortic vascular ring in Marfan’s Syndrome also in the later article by Pugh et al., as stated above (40).

The stress test for professional athletes is considered also in later publications discussing this issue (4) and will be conducted in athletes where any type of risk factor was located (1). A cardiac investigation, including various tests and a stress test or echo, will be conducted in any case where the athlete responded in the affirmative or was found to be positive in any of the 12 criteria of medical history (4, 17). In true responses it would be unusual that at least one of these would be positive. The questions include information concerning a tendency for momentary loss of consciousness in the past or loss of consciousness, pain or chest discomfort during stress, tiredness or shortness of breath during workout, “light headiness,” or a sense of palpitations. These questions complement the questions about family history, that include death before age 50 and other more trivial questions (28). Directed questioning “invites” a positive response and certain questions will be responded to in the affirmative by a large number of athletes. Once again, these athletes will be required to undergo further investigation, as stated above (17, 24).

A stress test also constitutes part of a regular investigation for athletes, where there is a suspicion of any anomaly in the electrocardiogram. Such changes are expected in 40%-50% of athletes (15).

The International Olympic Committee suggested additional investigation in athletes with higher risk factors or athletes over age 35. The echo and stress test were mentioned in this evaluation (17).

Corrado et al. in 2011 (1) discussed the availability and low price of the stress test, which constitutes the best evaluation for asymptomatic adults prior to commencing a physical activity program. The authors quote three papers that show a greater risk factor in those athletes with a positive test.
The stress test also enables receipt of other basic information as the level of physical fitness, hypertension at rest, hypertensive response under stress and the identification of respiratory or orthopedic disturbance which are expressed under stress. Asthma connected to physical activity (EIA - Exercise Induced Asthma or EIB - Exercise Induced Bronchospasm) limits the athlete’s physical ability, and is common in 10-12% of the population, even those who are not recognized as asthmatic patients or known asthmatic patients even when treated with bronchodilators (30, 31). The disease will be discovered during a spirometry after stress in most case of EIA (32). Other non-cardiac factors, for which information will be received during a stress test, include chest pain from a non-cardiac source, urticaria or anaphylaxis following physical activity, an unexplained decline in the athlete’s fitness, an over-training syndrome and functional blockage of blood vessels during activity.

The death rates in athletes, which were estimated in the past to be between 1:100,000 and 1:300,000 actually seem to be much higher, with a rate of 1:9,000 (11, 12) or 1:5,000 and higher over an athlete’s full career as a professional and amateur (29). Peidro et al. (39) mentioned higher death rates in athletes of 0.5 or 2.0 deaths a year per 100,000 athletes, or 10 to 40 over a 20 year career, meaning 1:2,500 to 1:10,000 cases. Such tragic cases probably occur following arrhythmia under stress.

Arrhythmia and death occur under stress (1) as do pathological changes in the electrocardiogram. Accordingly, the Italian protocol has included a step test, intended to determine recovery of pulse after stress, while simultaneously disclosing arrhythmia from physical exercise (1, 9).

Strauss, in his classical 1984 book (13), Corrado in 2000 (14), and Corrado et al. in their article in 2011 (15), indicated to the fact that hyperthermia or hypokalemia following stress might cause fatal ventricular arrhythmia, in athletes with risk factors. The stress test will disclose this tendency in those athletes.

In July 2008 the British medical journal, BMJ, published an article by Sofi et al. (6), reviewing the electrocardiogram at rest and under stress in 30,065 competitive athletes. Only 3.7% of those disqualified for competitive activity were selected
according to their medical history and physical examination. The comprehensive disqualification rate was 0.6%. 1,812 people (6% of athletes) displayed an anomaly in the ECG at rest, and 1,459 athletes (4.9% of athletes) displayed an anomaly during the stress test. Of these 1,227 athletes displayed a totally normal ECG at rest, while disturbances were discovered only in the stress test. In total, 159 athletes were disqualified due to suspicions of potential fatal cardiac pathologies, of which 126 (79%) would not have been disqualified without the stress test. About half of the population in which anomalies were discovered during the electrocardiogram were under age 30.

**Age for Conducting Stress Test**

Over and above the discussion of whether the stress test is required as a regular part of the PPE it should be discussed from what age it is recommended to conduct this test. A committee of the Israel Heart Society, in a document of September 12, 2010, suggests age 40 even though the consensus of the International Olympic Committee (17) requires a stress test for every athlete over age 35. To be noted that the publication does not differentiate between men and women in this regard.

In Corrado’s comprehensive article (1) one should take note of the records mentioning the age of applying the test, which in competitive athletes should begin already at the age 12 to 14. Also, the frequency of the test should be noted, which is conducted every year or two (1, 9) and every six months in two European countries, as stated below. Luxembourg requires pre-season tests from age 7, including a stress test, as detailed below.

In 2009 Maron reviewed 1,866 deaths in athletes (36), where the youngest was 8 and approximately 65% of deaths occurred under age 17. In soccer and basketball the average age of deaths was 16 to 17 (36).

The position paper of the American Academy of Pediatrics, written by Wilt et al., and published in 2012, mentions that in the United States every year about 2,000 people under age 25 die from Sudden Cardiac Arrest (SCA) (41, 42). The paper quotes five other sources stating that 0.8-6.2 cases per 100,000 children and adolescents die every year from SCA (41). The youngest registered death was age
The authors added, based on two other sources, that this rate seems to be rising (41). It was noted that when there is an underlying illness, SCA cases in this population rise during physical activity (20, 41, 43), as these are caused by arrhythmia, occurring under stress in 8-33% of the cases (41, 44, 45).

Steinvil et al stated that 20% of deaths that occurred in the past in Israel were in athletes under age 16; in ages 12, 14 (two cases), 15 and 16 (8). Marijon’s extended review of 820 sport-related deaths in athletes aged 10 to 75 registered a range of deaths from age 11 to age 75. The table in the article mentions 7 or 8 before age 15 (not mentioning numbers so it is difficult to calculate the exact number) (29). Based on that stated, it seems that it should be considered performing stress tests for athletes requiring high static and dynamic training already from age 12, as recommended to the Israel Ministry of Health by the Advisory Committee to the Israel Minister of Health on the Law of Sport in Israel (16).

**European practices regarding the stress test as part of athletes’ pre-season examination:**

In the following paragraphs this document will refer to the common practices in regard to the Pre-Participation Examination (PPE) in Europe. Our approach derives from the fact that Israel is affiliated to Europe in various sporting fields, including soccer, basketball, various Olympic fields and others, also regarding medical companies and associations.

An annual test is common is most European countries, if by law or as a regulation of the medical and sports associations, organizations that incorporate sports fields, the National Olympic Committee or the National scientific Organization dealing with sports medicine.

The data in this document was mainly provided out of a survey on the PPE’s in Europe made in the name of the European Federation of Sports Medicine Associations (EFSMA) by Prof. Peter Jenoure, from Lugano in Switzerland, a former teacher in sports medicine at the Universities of Basel, Neuchâtel, Lausanne, Geneva and Nice. Dr. Jenoure permitted us to observe his document in its entirety,
after the biennial meeting of EFSMA in Salzburg, Austria, held on October 27-29, 2011 (33). Prof Jenoure delivered an updated copy on August 2012.

In Belgium (Flemish) the written practice, also for insurance purposes, includes a stress test for athletes at risk, in most ball sports, including fields with higher risk factors. Tests are held once a year.

In France the test is regulated under state law, and includes top athletes. The test is held twice a year, and includes a stress test. It is interesting to note that the transthoracic echo test is also performed twice during an athlete’s career. The stress test is held at least once in four years throughout the athlete’s career. Athletes not registered as top athletes (about 17,000 people) are required to take an annual test, but requirements have not been regulated.

In Germany a pre-season examination is compulsory and also includes a stress test and echo. These are broadened to include leisure time athletes on any suspicious finding, and then a stress test and echo are performed along side a detailed and thorough investigation. The test also includes spirometry, echo, chest x-ray and blood and urine samples. The tests are conducted as well on all Premium League soccer players.

Pre-season tests are held in Italy by law since 1982. The examination includes a stress test. Athletes on all levels are required to take a step test as part of the pre-season examination, which also includes anthropometrics, spirometry, urine samples and an eye test.

The pre-season examination in Luxembourg has been held by law since 1957. In those athletes who are required to be examined, this also includes a stress test. The test is compulsory once every 5 years, and includes in top athletes spiroergometry (stress test with spirometry) and lactate measurements in blood. To be noted that tests begin at age 7 (!).

In Poland the examination is compulsory by law and also includes a stress test. The examination is held once every 6 (!) months, and includes blood and urine samples. An echo, Holter and MRI are performed as needed.
An additional investigation disclosed that in Poland examinations are held yearly for competitive athletes and twice a year for a choice group of 2,800 athletes, under the authority of the National Center for Sports Medicine, affiliated to the Polish Ministry of Health. These include an electrocardiogram at rest, stress test, chest x-ray, eye test, blood samples and spirometry. Examinations are performed on trainers as well (following a conversation with Prof. Gregor Adamchik, President of the Polish Association for Sports Trauma and doctor of the Polish volleyball team).

In Bulgaria PPE is mandatory by State Law. It is performed once or twice a year, depending on the specific sport. It includes an orthopaedic and general clinical examination, anthropometry, ECG at rest, blood and urine tests and spiroergometry.

In Romania the examination is compulsory by law and also includes a stress test. The examination is held once every 6 (!) months, and includes blood and urine samples, and anthropometry.

In Estonia the examination is compulsory by law and includes, amongst others, anthropometry, spirometry at rest and under stress, a stress test, and blood and urine sample. The examination is conducted once a year on athletes who train more than 8 hours a week, and once in two years for athletes who train 5-8 hours a week.

In Turkey the examination is compulsory by law and in Olympic fields includes Performance Evaluation Tests. The examination is held once a year. We referred several questions to our colleagues in Turkey and from their responses understood that the stress test is included in these examinations.

In Serbia top athletes must undergo examinations twice a year, including a medical questionnaire, anthropometric measurements, spirometry, a physical examination, blood and urine samples, electrocardiogram at rest and spiroergometry, which are mandatory according to the sport law of Serbia. Examination is compulsory in full for Olympic and for state financed sportsmen, partially compulsory for minors and disabled, and not compulsory though recommended for recreational athletes.
In **Cyprus** the examination is compulsory every year by law, since 1991. A cardiac evaluation is performed every 3 years, inclusive of ECG at rest, chest x-ray and blood and urine samples.

In **Austria** the examination is held according to the Austrian Association for Sport Medicine and Prevention (ASSMP), including an electrocardiogram at rest. The examination is not demanded by State Law.

In **Greece** the examination is compulsory every year by law, and includes an ECG at rest, echo “as required,” chest x-ray and blood and urine samples.

In **Sweden** the examination is not compulsory and is recommended, according to the European Cardiologic Association, by the Swedish Sports Federation in 2005, for top athletes from age 16. The examination includes an ECG at rest. It should be noted that the Swedish sports federations tend to adopt the FIFA and UEFA recommendation and include an echo in top league soccer teams (33).

The requirement in **Switzerland** for Pre-Participation Examination is not compulsory by law, but to be held every year as recommended by the Swiss Olympic Committee. The examination includes an electrocardiogram at rest and blood and urine samples. The Swiss Olympic Committee has suggested complementing this examination with various stress tests ("Exercise Physiology Tests") for top athletes.

In **Russia** PPE is performed under legislation of the Russian Federation. The three lower grades include a thorough physical examination, EEG, ECG and ECHO, chest x-ray, blood and urine samples, and a consultation. The two top grades include ECG, a stress test, ultrasound and an ECHO with stress test. All examinations are performed in a network of sports medicine clinics.

Other countries in Europe that conduct a stress test as part of the pre-season examination for athletes are **Hungary**, where the test is performed by the National Institute of Sports Medicine and, to the best of our knowledge, also in **Slovenia**, where the examination is compulsory by law since 1998.
In Great Britain there is no governmental requirement for Pre-Participation Examination. Even so, the English football league requires an electrocardiogram at rest and echo for every player over age 12, while the top league also requires a stress test (26).

The Union of European Football Associations (UEFA) requires, in addition to an ECG at rest, an echo once throughout each player’s career, and a stress test in the case of any clinical uncertainty or problem deriving from the medical history.

The article of Corrado et al. (1) collects information on what is going on in other countries. This data is taken from a previous paper of his, written in 2008 (10), so that it is possible that it is not updated. Four countries regularly perform the echo (Norway, Germany, France and Holland) and two require a stress test (Germany and France).

The top Belgian football team Anderlecht performs an electrocardiogram at rest and under stress, echo, extensive eye test and a rather large number of imaging tests. Every player undergoes a stress test once a year and an echo twice a year. This examination is not compulsory by law, but it has been found common in most senior football teams in Belgium (following conversation with Prof. José Huylebroek, former President of EFOST and doctor of the Anderlecht team).

A summary of the material shows that stress testing is compulsory in 15 or 16 countries (in Great Britain there is a lack of information) and an echo is performed in 3 other countries that do not require a stress test. Information has not yet been submitted by 11 other European countries, for which there are currently no details available, namely Albania, Belarus, Bosnia Herzegovina, Croatia, Czech Republic, Finland, Georgia, Latvia, Lithuania, Slovenia and Ukraine.

Proposal of the Advisory Committee to the Minister of Health of Israel Regarding Amendments to Regulations in the Health Law:

According to that stated above, the committee advised that it was correct to preserve the stress test for several sports fields within the regulations (16). For this purpose the committee used Mitchell’s article (25), in which he presented a
A table estimating the physical stress, dynamic stress and static stress imposed on each athlete in various sports fields. The table includes 64 fields of sport; according to the following division (combat fields have been combined into one field):

<table>
<thead>
<tr>
<th>Stress Combination</th>
<th>Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low dynamic stress and low static stress</td>
<td>6</td>
</tr>
<tr>
<td>Low dynamic stress and medium static stress</td>
<td>5</td>
</tr>
<tr>
<td>Low dynamic stress and high static stress</td>
<td>10</td>
</tr>
<tr>
<td>Medium dynamic stress and low static stress</td>
<td>5</td>
</tr>
<tr>
<td>Medium dynamic stress and medium static stress</td>
<td>8</td>
</tr>
<tr>
<td>Medium dynamic stress and high static stress</td>
<td>5</td>
</tr>
<tr>
<td>High dynamic and low static stress</td>
<td>7</td>
</tr>
<tr>
<td>High dynamic stress and medium static stress</td>
<td>7</td>
</tr>
<tr>
<td>High dynamic stress and high static stress</td>
<td>8</td>
</tr>
</tbody>
</table>

**Up to age 12:**

Up to age 12 the committee recommends not to perform stress tests, unless the examining physician suspects there is a reason to do so.

**Age 12 to 25:**

With minimal changes deriving from Israeli conditions, the committee suggested that stress tests be held as part of pre-season examinations in 28 sports fields, from age 12.

28 fields will be exempt from this test as long as athletes are under age 25.
Age 25 to 35:

Six sports fields will be exempt from including the stress test in Pre-Participation Examination until athletes reach age 35.

Over 35:

Seven sports fields will be exempt from stress tests at all ages.

The committee evaluated that this division would be an appropriate "middle path" between the tendency to save money and ease the situation for the sports associations and the need to ensure the cardiovascular safety of athletes.

Summary

1. The rate of athletes suffering from life-threatening cardiac findings as a possible factor for arrhythmia under stress is approximately 0.5% (1 of every 200) (1), and the real death rate might reach 1:9,000 person years (11, 12) or 1:5,000 and more over a 20-year professional and amateur career of an athlete (29).
2. The advisory committee to the Minister of Heath of Israel on sports legislation suggested, in a document dated May 13, 2009 (16), to limit stress tests only to athletes undergoing significant dynamic stress, who are candidates for arrhythmia under stress if they suffer from any pre-existing cardiac condition.
3. After re-reading all the available medical material, the committee restates its unequivocal recommendation to update regulations, as delivered on May 13, 2009 and updated on December 1, 2011 (16), and to preserve the stress test as part of the PPE in selected sports fields.

Bibliography


37. FIMS recommendations for pre-season examination in sport. Accepted September 1994.
Meniscal Repair Outcomes at Greater Than Five Years: A Systematic Literature Review and Meta-Analysis

Jeffrey J. Nepple, Warren R. Dunn, Rick W. Wright


Background. Meniscal repair offers the potential to avoid the long-term articular cartilage deterioration that has been shown to result after meniscectomy. Failure of the meniscal repair can occur several years postoperatively. Limited evidence on the long-term outcomes of meniscal repair exists.

Methods. We performed a systematic review of studies reporting the outcomes of meniscal repair at a minimum of five years postoperatively. Pooling of data and meta-analysis with a random-effects model were performed to evaluate the results.

Results. Thirteen studies met the inclusion criteria. The pooled rate of meniscal repair failure (reoperation or clinical failure) was 23.1% (131 of 566). The pooled rate of failure varied from 20.2% to 24.3% depending on the status of the anterior cruciate ligament (ACL), the meniscus repaired, and the technique utilized. The rate of failure was similar for the medial and the lateral meniscus as well as for patients with an intact and a reconstructed ACL.

Conclusions. A systematic review of the outcomes of meniscal repair at greater than five years postoperatively demonstrated very similar rates of meniscal failure (22.3% to 24.3%) for all techniques investigated. The outcomes of meniscal repair at greater than five years postoperatively have not yet been reported for modern all-inside repair devices.
Repair of meniscal tears associated with tibial plateau fractures: a review of 15 cases.


Background. Tibial plateau fractures are frequently associated with meniscal tears. Little is known about the results of meniscal repair in this group of patients.

Purpose. To determine the results of repair of meniscal tears found during arthroscopically assisted reduction and internal fixation (ARIF) of tibial plateau fractures.

Study Design. Case series; Level of evidence, 4.

Methods. In a cohort of 51 tibial plateau fractures treated with ARIF, 15 associated meniscal tears (15 knees) in 14 patients were repaired. There were 12 peripheral longitudinal tears of the lateral meniscus, 1 longitudinal peripheral tear of the medial meniscus, 1 full-thickness radial tear of the lateral meniscus, and 1 bird-beak tear of the lateral meniscus. Repairs were performed using an outside-in technique for the anterior horn and all-inside repair for the body and posterior horn lesions. Mean (SD) age at operation was 47.3 (14.0) years. Patients were followed for a mean (SD) of 4.83 (1.01) years and evaluated using the Rasmussen, Honkonen, Lysholm, Tegner, and International Knee Documentation Committee (IKDC) scores. A second-look arthroscopy was performed in 13 knees a mean (SD) of 14.2 (10.1) months after the initial surgery.

Results. The mean (SD) Rasmussen score was 29.1 (0.96). Thirteen of 15 patients scored good or excellent results in all Honkonen sections. The mean (SD) Lysholm score was 88.6 (12.4). The mean (SD) IKDC score was 79.3 (19.3). There was a small decrease of the activity level according to the Tegner score when compared with the preoperative situation (1.20 [1.82], P = .022). There were not any meniscal symptoms in any case. Of the 13 menisci evaluated with second-look arthroscopy, 12 had healed completely and a radial tear had healed partially in the vascular zone. In one of the cases that healed, a new tear was found in a different location.

Conclusion. Meniscal repair of tears associated with tibial plateau fractures has good results. All patients had good or excellent clinical results. Second-look arthroscopy confirmed complete healing in 92% of meniscal tears when performed.
Treatment for Acute Anterior Cruciate Ligament Tear: Five Year Outcome of Randomised Trial.

Frobell RB, Roos HP, Roos EM, Roemer FW, Ranstam J, Lohmander LS.

BMJ. 2013 Jan 24;346:f232

Objective. To compare, in young active adults with an acute anterior cruciate ligament (ACL) tear, the mid-term (five year) patient reported and radiographic outcomes between those treated with rehabilitation plus early ACL reconstruction and those treated with rehabilitation and optional delayed ACL reconstruction.

Participants. 121 young, active adults (mean age 26 years) with an acute ACL injury to a previously uninjured knee. One patient was lost to five year follow-up.

Intervention. All patients received similar structured rehabilitation. In addition to rehabilitation, 62 patients were assigned to early ACL reconstruction and 59 were assigned to the option of having a delayed ACL reconstruction if needed.

Main Outcome Measure. The main outcome was the change from baseline to five years in the mean value of four of the five subscales of the knee injury and osteoarthritis outcome score (KOOS(4)). Other outcomes included the absolute KOOS(4) score, all five KOOS subscale scores, SF-36, Tegner activity scale, meniscal surgery, and radiographic osteoarthritis at five years.

Results. Thirty (51%) patients assigned to optional delayed ACL reconstruction had delayed ACL reconstruction (seven between two and five years). The mean change in KOOS(4) score from baseline to five years was 42.9 points for those assigned to rehabilitation plus early ACL reconstruction and 44.9 for those assigned to rehabilitation plus optional delayed reconstruction (between group difference 2.0 points, 95% confidence interval -8.5 to 4.5; P=0.54 after adjustment for baseline score). At five years, no significant between group differences were seen in KOOS(4) (P=0.45), any of the KOOS subscales (P ≥ 0.12), SF-36 (P ≥ 0.34), Tegner activity scale (P=0.74), or incident radiographic osteoarthritis of the index knee (P=0.17). No between group differences were seen in the number of knees having meniscus surgery (P=0.48) or in a time to event analysis of the proportion of meniscuses operated on (P=0.77). The results were similar when analysed by treatment actually received.

Conclusion. In this first high quality randomised controlled trial with minimal loss to follow-up, a strategy of rehabilitation plus early ACL reconstruction did not provide better results at five years than a strategy of initial rehabilitation with the option of having a later ACL reconstruction. Results did not differ between knees surgically reconstructed early or late and those treated with rehabilitation alone. These results should encourage clinicians and young active adult patients to consider rehabilitation as a primary treatment option after an acute ACL tear.
Survival of the Anterior Cruciate Ligament Graft and the Contralateral ACL at a Minimum of 15 Years

Henry E. Bourke, Lucy J. Salmon, Alison Waller, Victoria Patterson, and Leo A. Pinczewski


Background. The risks for primary anterior cruciate ligament (ACL) rupture have been established. What is less well known is the risk of graft rupture after reconstruction and also the risk of a primary ACL rupture in the contralateral knee.

Purpose. To determine the long-term survival of the ACL graft and the contralateral ACL (CACL) after reconstruction and to identify factors that increase the odds of subsequent ACL injury.

Methods. All patients having undergone primary ACL reconstruction in 1993 or 1994 by a single surgeon in a single unit were considered. Patients were contacted to complete a subjective interview by telephone or e-mail questionnaire at a minimum of 15 years after surgery.

Results. A total of 755 patients met the inclusion criteria, and ACL reconstruction was performed using a single-incision endoscopic technique with either autologous bone–patellar tendon–bone graft (BPTB; n = 314) or hamstring tendon graft (HT; n = 359) and metal interference screw fixation. Of these patients, 673 (89%) completed the questionnaire; 23% had sustained either a graft rupture or CACL rupture. Expected survival of the ACL graft was 95%, 93%, 91%, and 89% at a respective 2, 5, 10, and 15 years after reconstruction. Expected survival of the CACL was 97%, 93%, 90%, and 87%, respectively. Survival of the ACL graft was less favorable in men than in women (P = .007); ACL graft survival was not significantly different between the HT (88%) or BPTB (91%) groups (P = .149). Rupture of the CACL occurred twice as frequently as graft rupture in the BPTB group (graft survival, 84% vs 89%; P = .003). A positive family history of ACL rupture doubled the odds of both ACL graft and CACL rupture. The mean International Knee Documentation Committee subjective score at 15 years was 85. Return to preinjury sport level was reported in 73% of patients, and 51% were still participating in strenuous or very strenuous activities at 15 years.

Conclusion. Fifteen years after ACL reconstruction, expected survival of the ACL graft was 89% and expected survival of the CACL was 86%. Graft choice did not affect ACL graft rupture, but using BPTB increased the risk of CACL rupture compared with HT. Men had a less favorable survival rate of the ACL graft than did women, and a family history of ACL rupture increased the risk of both ACL graft and CACL rupture.
Bilateral magnetic resonance imaging and functional assessment of the semitendinosus and gracilis tendons a minimum of 6 years after ipsilateral harvest for anterior cruciate ligament reconstruction.

Åhlén M, Lidén M, Bovaller Å, Sernert N, Kartus J.


**Background.** Previous studies are contradictory in terms of the function, regeneration potential, insertion point, and cross-sectional area of the semitendinosus and gracilis tendons after harvest for anterior cruciate ligament (ACL) reconstruction.

**Hypotheses.** In the long term, the tendons will regenerate in most patients with a more proximal point of insertion, the cross-sectional area of the tendons will be smaller compared with the nonoperated contralateral side, and the patients will be weaker in terms of the internal rotation and deep flexion of the knee.

**Methods.** Nineteen patients (9 women and 10 men) who had undergone ACL reconstruction a minimum of 6 years earlier, median 8.5 years (range, 6-11 years), with ipsilateral semitendinosus and gracilis autografts, underwent bilateral magnetic resonance imaging (MRI) of their knees. An experienced, independent musculoskeletal radiologist evaluated all MRI examinations. To evaluate the function, strength measurements in deep knee flexion and internal rotation were performed using an isokinetic strength-testing machine.

**Results.** The semitendinosus tendon had regenerated in 17 of 19 (89%) patients and the gracilis tendon in 18 of 19 (95%) patients, as seen on MRI. There were no significant differences between the point of insertion for the tendons on the operated and nonoperated sides. The cross-sectional areas of the regenerated tendons revealed no significant differences compared with the normal tendons on the contralateral side, as measured 4 cm above the joint line. The patients were significantly weaker in terms of deep knee flexion at 60 and 180 deg/sec, but they were stronger in terms of internal rotation of the tibia at 60 deg/sec in the operated leg compared with the nonoperated leg.

**Conclusion.** The semitendinosus and gracilis tendons regenerated in the majority of patients and regained an almost normal point of insertion on the pes anserinus a minimum of 6 years after harvest. The regenerated tendons had a cross-sectional area similar to that on the nonoperated contralateral side. The patients revealed a strength deficit in deep knee flexion but not in internal rotation.
Evaluation of Muscle Size and Fatty Infiltration with MRI Nine to Eleven Years Following Hamstring Harvest for ACL Reconstruction

Brian J. Snow, Jason J. Wilcox, Robert T. Burks, Patrick E. Greis


Background. The long-term effect of hamstring tendon harvest for anterior cruciate ligament (ACL) reconstruction on muscle morphology is not well documented. Our hypothesis was that harvest of the hamstring tendons for ACL reconstruction would result in persistent loss of volume and cross-sectional area of the gracilis and semitendinosus muscles.

Methods. Magnetic resonance images were made of both limbs of ten patients nine to eleven years after they had ACL reconstruction with ipsilateral hamstring autograft. The volume of the individual thigh muscles bilaterally was calculated. The peak cross-sectional area and the cross-sectional area 7 cm proximal to the joint line was measured for the gracilis and semitendinosus muscles. Data were evaluated with use of the paired t test and Wilcoxon signed-rank test. The gracilis and semitendinosus muscles on the operatively treated side were evaluated for fatty infiltration and tendon regeneration.

Results. The mean volume on the operatively treated side was 54.2% of that on the noninvolved side for the gracilis muscle and 58.5% for the semitendinosus muscle. A 7% decrease in quadriceps volume and an 8% increase in the volume of the long head of the biceps on the operatively treated extremity were noted. The semimembranosus muscle and short head of the biceps muscle showed no difference in volume. The gracilis and semitendinosus muscles also showed a decrease in peak cross-sectional area, a decrease in the cross-sectional area 7 cm proximal to the joint line, and evidence of fatty infiltration. There was variable evidence of tendon or scar formation within the tendon bed, with most patients having some tissue that blended into either the sartorius muscle or medial gastrocnemius fascia at a level proximal to the joint line.

Conclusions. At nine to eleven years after ACL reconstruction with ipsilateral hamstring autograft, the gracilis and semitendinosus muscles showed persistent atrophy on the operatively treated side with evidence of fatty infiltration and variability in tendon regeneration. There was also persistent atrophy of the quadriceps muscles and compensatory hypertrophy of the long head of the biceps.
Clinical and radiological outcomes 5 years after matrix-induced autologous chondrocyte implantation in patients with symptomatic, traumatic chondral defects.


Background. To date, few studies have been published reporting the 5-year follow-up of clinical and radiological outcomes for chondral defects treated with matrix-induced autologous chondrocyte implantation (MACI).

Hypothesis. A significant improvement in clinical and radiological outcomes after treatment of symptomatic, traumatic chondral defects of the knee with the MACI implant will be maintained up to 5 years after surgery.

Methods. A prospective evaluation of the MACI procedure was performed in 21 patients with chondral defects of the knee. After the MACI procedure, patients were clinically assessed with the Knee injury and Osteoarthritis Outcome Score (KOOS), the Tegner-Lysholm score, the International Knee Documentation Committee (IKDC) Subjective Knee Form, and the modified Cincinnati score at years 1, 2, and 5. The quality of repair tissue was assessed by magnetic resonance imaging using the magnetic resonance observation of cartilage repair tissue (MOCART) score at months 3 and 6 and years 1, 2, and 5.

Results. Significant improvements (P < .05) were observed for all 5 KOOS subcategories at year 1 and were maintained through year 5 in 90.5% of patients (19/21). Treatment failure occurred in only 9.5% of patients (2/21). Significant improvements (P < .05) from baseline to year 5 were also observed for the IKDC score (30.1 to 74.3), the modified Cincinnati score (38.1 to 79.6), and the Tegner-Lysholm activity score (1.8 to 4.3). Similarly, the MOCART score significantly improved (P < .001) from baseline to year 5 (52.9 to 75.8). After 5 years, complete filling (83%) and integration (82%) of the graft were seen in the majority of patients. Signs of subchondral bone edema were still present in 47% of patients at 5 years. No product-specific adverse events were reported over the 5-year follow-up period.

Conclusion. Patients treated with a MACI implant demonstrated significant clinical improvement and good quality repair tissue 5 years after surgery. The MACI procedure was shown to be a safe and effective treatment for symptomatic, traumatic chondral knee defects in this study.
Acute Achilles Tendon Rupture: A Questionnaire Follow-up of 487 Patients

Dan Bergkvist, Ingrid Åström, Per-Olof Josefsson, Leif E. Dahlberg


Background. The optimum treatment of acute total Achilles tendon rupture remains controversial. In the present study, the outcomes of surgical and nonsurgical treatment in a large number of patients were compared on the basis of patient age and sex.

Methods. The records of all 487 patients with an acute total Achilles tendon rupture that had occurred between 2002 and 2006 and had been treated at one of two university hospitals in Sweden were manually reviewed. Surgical treatment was primarily used at Hospital 1, whereas nonoperative functional treatment was primarily used at Hospital 2. At one to seven years after the rupture, the majority of the patients were evaluated for complications, the Achilles Tendon Total Rupture Score was calculated, a heel-raise test was performed, and calf circumference was measured. The outcomes of surgical and nonsurgical treatment were compared on the basis of patient age and sex.

Results. The mean age at the time of the injury was forty-five years. In the surgical treatment group at Hospital 1, six (3%) of 201 patients had a re-rupture and three (1.5%) had an infection. In the nonsurgical treatment group at Hospital 2, the rate of re-rupture rate was 6.6% (fifteen of 227). When the results for the surgical treatment group at Hospital 1 were compared with those for the nonsurgical treatment group at Hospital 2, there was no significant difference in terms of the mean Achilles Tendon Total Rupture Score (81.7 compared with 78.9; p = 0.1), but both the difference in the heel-raise test (p = 0.01) and the difference in calf circumference (1.4 compared with 2.0 cm; p = 0.01) reached significance in favor of surgery. Nonsurgically managed female patients showed significant worsening of the Achilles Tendon Total Rupture Score and heel-raise test with increasing age at the time of injury.

Conclusions. The good Achilles Tendon Total Rupture Score in the nonsurgically managed group, together with the relatively low rate of re-ruptures and other complications in these patients, makes this treatment a preferable option for most patients. However, the tendency for a lower re-rupture rate and better performance on the heel-raise test in surgically treated patients suggest surgery may be beneficial in selected patients.
A Multicenter Randomized Controlled Trial Comparing Single-Row with Double-Row Fixation in Arthroscopic Rotator Cuff Repair

Peter L.C. Lapner, Elham Sabri, Kawan Rakhra, Sheila McRae, Jeff Leiter, Kimberly Bell, Peter MacDonald.


Background. Controversy exists regarding the optimal technique for arthroscopic rotator cuff repair. The purpose of this multicenter, randomized, double-blind controlled study was to compare the functional outcomes and healing rates after use of single-row and double-row suture techniques for repair of the rotator cuff.

Methods. Ninety patients undergoing arthroscopic rotator cuff repair were randomized to receive either a single-row or a double-row repair. The primary objective was to compare the Western Ontario Rotator Cuff Index (WORC) score at twenty-four months. Secondary objectives included comparison of the Constant and American Shoulder and Elbow Surgeons (ASES) scores and strength between groups. Anatomical outcomes were assessed with magnetic resonance imaging (MRI) or ultrasonography to determine the postoperative healing rates.

Results. Baseline demographic data including age (p = 0.29), sex (p = 0.68), affected side (p = 0.39), and rotator cuff tear size (p = 0.28) did not differ between groups. The WORC score did not differ significantly between groups at any time point (p = 0.48 at baseline, p = 0.089 at three months, p = 0.52 at six months, p = 0.83 at twelve months, and p = 0.60 at twenty-four months). The WORC score at each postoperative time point was significantly better than the baseline value. The Constant score, ASES score, and strength did not differ significantly between groups at any time point. Logistic regression analysis demonstrated that a smaller initial tear size and double-row fixation were associated with higher healing rates.

Conclusions. No significant differences in functional or quality-of-life outcomes were identified between single-row and double-row fixation techniques. A smaller initial tear size and a double-row fixation technique were associated with higher healing rates as assessed with ultrasonography or MRI.
Long-Term Outcome of Arthroscopic Massive Rotator Cuff Repair: The Importance of Double-Row Fixation

Patrick J. Denard, Alisha Z. Jiwani, Alexandre Lädermann, Stephen S. Burkhart

Arthroscopy 2012 Jul;28(7):909-15

Purpose. The purpose of this study was to (1) evaluate the long-term functional outcome of arthroscopic rotator cuff repair of massive rotator cuff tears (RCTs) and (2) compare double-row (DR) and single-row (SR) repairs.

Methods. This was a retrospective review of massive RCTs treated with an arthroscopic rotator cuff repair over an 8-year period. Minimum 5-year follow-up was available for 126 repairs at a mean of 99 months. Among 107 complete repairs, there were 62 SR and 45 DR repairs. Functional outcome was determined by University of California, Los Angeles (UCLA) and American Shoulder and Elbow Surgeons scores. A multivariate analysis was performed to examine the role of a DR repair.

Results. For all repairs combined, improvements were observed in forward flexion (132° v 168°), pain (6.3 v 1.3), UCLA score (15.7 v 30.7), and American Shoulder and Elbow Surgeons score (41.7 v 85.7) (P < .001). A good or excellent outcome, obtained in 78% of cases, was associated with a complete repair (P = .035) and a DR repair (P = .008). When we excluded partial repairs, postoperative UCLA gain was greater after a DR repair (P = .007). Patients reported their shoulder as feeling closer to normal after a DR repair compared with an SR repair (93.5% v 84.4%, P = .006). A DR repair was 4.9 times more likely to lead to a good or excellent outcome (P = .021).

Conclusions. When a DR repair of a massive RCT is possible, on the basis of the ability to mobilize the tendons, a better long-term functional outcome can be expected compared with an SR repair. Given the known high risk of recurrence after repair of massive RCTs and the knowledge that functional outcome is related to recurrence, a DR repair of massive RCTs should be performed when there is sufficient tendon mobility.
Suture Number Determines Strength of Rotator Cuff Repair

Patrick W. Jost, M. Michael Khair, Dan X. Chen, Timothy M. Wright, Anne M. Kelly, Scott A. Rodeo

J Bone Joint Surg Am, 2012 Jul 18;94(14):e100

Background. Failure of surgical repair of a rotator cuff tear continues to be a clinical problem. For other tendon repairs, increasing the number of sutures improves both biomechanical performance and clinical outcomes. Several investigators have shown biomechanical advantages of double-row techniques but have used many more sutures than were used with the single-row techniques with which the double-row techniques were compared. The purposes of our study were to establish whether using a greater number of sutures would improve the biomechanical properties of a rotator cuff repair model, and whether using equal numbers of sutures would lead to equivalent results between single- and double-row configurations.

Methods. Fresh-frozen sheep infraspinatus tendons underwent single-row repair with two, four, or six mattress sutures and double-row repair with use of four mattress sutures. Specimens were pretensioned at 10 N for one minute, then cycled from 10 to 180 N for 200 cycles at 0.2 Hz; this was followed by load to failure. Cyclic gap formation, failure load, and failure type were recorded.

Results. The four-suture single-row and four-suture double-row repairs had similar gap formation during cyclic testing, with no significant differences between them. Cyclic gap formation in the two-suture single-row group was 6.7 and 7.1 mm (97% and 109%) greater than that in the four and six-suture single-row groups after 200 cycles (p < 0.001). The average loads to failure of the two, four, and six-suture single-row groups were 274, 362, and 572 N (p < 0.0001). The average load to failure of the four-suture double-row group was 386 N, which was similar to the value in the four-suture single-row group (p = 0.58).

Conclusions. In an ovine rotator cuff tendon repair model, increasing the number of sutures decreased cyclic gap formation and increased load to failure. Single and double-row repairs are biomechanically equivalent when the number of sutures is kept constant.

Clinical Relevance. The results of this study support the use of greater numbers of sutures in rotator cuff repair and disagree with the assertion that double-row repairs are biomechanically superior to single-row repairs.
**Remplissage Repair—New Frontiers in the Prevention of Recurrent Shoulder Instability: A 2-Year Follow-up Comparative Study**

Francesco Franceschi, Rocco Papalia, Giacomo Rizzello, Edoardo Franceschetti, Angelo Del Buono, Manlio Panasci, Nicola Maffulli, and Vincenzo Denaro


**Background.** An engaging Hill-Sachs lesion is a defect of the humeral head, large enough to cause locking of the humeral head against the anterior corner of the glenoid rim when the arm is at 90° of abduction and more than 30° of external rotation.

**Hypothesis.** When Bankart lesions are associated with engaging Hill-Sachs defects, simultaneous Bankart repair and remplissage provide lower recurrence rates than does Bankart repair alone.

**Methods.** Fifty patients (36 men, 14 women) with combined engaging Hill-Sachs and Bankart lesions were evaluated, before and after arthroscopic management, at a minimum follow-up of 2 years. After imaging and arthroscopic assessment, 25 patients underwent remplissage and Bankart repair, and 25 patients received Bankart repair alone. Patients were evaluated using the UCLA, Constant, and Rowe scores, and range of motion was measured using a goniometer. Postoperatively, all patients underwent magnetic resonance imaging to assess the status of healing of the anterior labrum and whether the tenodesis of the infraspinatus covered the Hill-Sachs defect.

**Results.** At the last appointment, active forward elevation, external rotation beside the body, internal rotation, and all administered scores were significantly improved compared with baseline assessment, with no statistically significant intergroup differences. A new posttraumatic dislocation occurred in 5 patients, all from the Bankart-only group (20%).

**Conclusion.** Remplissage is a safe, relatively short procedure that allows the surgeon to address large humeral defects with a low postoperative recurrence rate. Humeral head large defects predispose to recurrent instability of the shoulder and deserve surgical management.
The clinical and radiological outcome of pulsed electromagnetic field treatment for acute scaphoid fractures: a randomised double-blind placebo-controlled multicentre trial.

Hannemann PF, Göttgens KW, van Wely BJ, Kolkman KA, Werre AJ, Poeze M, Brink PR.


Abstract. The use of pulsed electromagnetic fields (PEMF) to stimulate bone growth has been recommended as an alternative to the surgical treatment of ununited scaphoid fractures, but has never been examined in acute fractures. We hypothesised that the use of PEMF in acute scaphoid fractures would accelerate the time to union by 30% in a randomised, double-blind, placebo-controlled, multicentre trial. A total of 53 patients in three different medical centres with a unilateral undisplaced acute scaphoid fracture were randomly assigned to receive either treatment with PEMF (n = 24) or a placebo (n = 29). The clinical and radiological outcomes were assessed at four, six, nine, 12, 24 and 52 weeks. A log-rank analysis showed that neither time to clinical and radiological union nor the functional outcome differed significantly between the groups. The clinical assessment of union indicated that at six weeks tenderness in the anatomic snuffbox (p = 0.03) as well as tenderness on longitudinal compression of the scaphoid (p = 0.008) differed significantly in favour of the placebo group. We conclude that stimulation of bone growth by PEMF has no additional value in the conservative treatment of acute scaphoid fractures.
Ganglions of the Wrist and Associated Triangular Fibrocartilage Lesions: A prospective study in arthroscopically-treated patients

I. Langner, PC Krueger, HR Merk, A Ekkernkamp, A Zach

J Hand Surg Am. 2012 Aug;37(8):1561-7

Purpose. Wrist ganglions are the most common soft tissue tumors of the hand and wrist and can occur at any age. Their etiology remains controversial. A high prevalence of associated intrinsic ligamentous lesions has been described. We hypothesized that painful wrist ganglions are an indicator of an underlying joint abnormality, particularly of lesions of the triangular fibrocartilage complex (TFCC). The aim of our study was to prospectively determine the prevalence of associated TFCC lesions in patients with painful wrist ganglions.

Methods. Forty-six patients (35 women, 11 men; mean age, 36 ± 11 y; range, 18-57 y) with painful wrist ganglions (20 radiopalmar and 26 dorsal) had surgery from January 2008 to June 2010. There were 18 primary and 28 recurrent ganglions. Clinical examinations, pain score evaluations, disabilities in daily life evaluations, plain radiographs, and magnetic resonance imaging were obtained before arthroscopic resection. Concomitant intrinsic lesions of the wrist were assessed with magnetic resonance imaging and re-evaluated by arthroscopy.

Results. All ganglions were successfully resected. Overall, arthroscopy identified 22 TFCC lesions (48%) and 2 intracarpal ligament lesions. The TFCC perforations were more commonly associated with radiopalmar ganglions with a positive ulnocarpal stress test result and with recurrent radiopalmar ganglions. At 1-year follow-up, all patients were meaningfully improved in terms of pain and disabilities in daily life.

Conclusions. Arthroscopy allows for the simultaneous treatment of ganglions and other pathologies. Therefore, arthroscopy should be contemplated as the primary treatment option for patients with painful ganglions of the wrist if they are in a radiopalmar location with a positive ulnocarpal stress test and for patients with recurrent radiopalmar ganglions, which are also highly associated with TFCC abnormalities.

Type of Study/Level of Evidence. Therapeutic IV.
The Impact of Epidural Steroid Injections on the Outcomes of Patients Treated for Lumbar Disc Herniation: A Subgroup Analysis of the SPORT Trial

Kristen Radcliff, Alan Hilibrand, Jon D. Lurie, Tor D. Tosteson, Lawrence Delasotta, Jeffrey Rihn, Wenyan Zhao, Alexander Vaccaro, Todd J. Albert, James N. Weinstein

J Bone Joint Surg Am. 2012 Aug 1;94(15):1353M8

Background. The Spine Patient Outcomes Research Trial (SPORT) is a prospective, multicenter study of operative versus nonoperative treatment of lumbar intervertebral disc herniation. It has been suggested that epidural steroid injections may help improve patient outcomes and lower the rate of crossover to surgical treatment.

Methods. One hundred and fifty-four patients included in the intervertebral disc herniation arm of the SPORT who had received an epidural steroid injection during the first three months of the study and no injection prior to the study (the ESI group) were compared with 453 patients who had not received an injection during the first three months of the study or prior to the study (the No-ESI group).

Results. There was a significant difference in the preference for surgery between groups (19% in the ESI group compared with 56% in the No-ESI group, p < 0.001). There was no difference in primary or secondary outcome measures at four years between the groups. A higher percentage of patients changed from surgical to nonsurgical treatment in the ESI group (41% versus 12% in the No-ESI, p < 0.001).

Conclusions. Patients with lumbar disc herniation treated with epidural steroid injection had no improvement in short or longterm outcomes compared with patients who were not treated with epidural steroid injection. There was a higher prevalence of crossover to nonsurgical treatment among surgically assigned ESI-group patients, although this was confounded by the increased baseline desire to avoid surgery among patients in the ESI group. Given these data, we concluded that more studies are necessary to establish the value of epidural steroid injection for symptomatic lumbar intervertebral disc herniation.

Level of Evidence. Therapeutic Level II.
Injury Profile in Elite Female Basketball Athletes at the Women’s National Basketball Association Combine

McCarthy MM, Voos JE, Nguyen JT, Callahan L, Hannafin JA.


Background. Anterior cruciate ligament (ACL) and meniscus injuries are common in female athletes participating in cutting and pivoting sports such as basketball. The epidemiological characteristics of injury in athletes seen at the Women’s National Basketball Association (WNBA) combine and the effect of ACL reconstruction and meniscus surgery on longevity in the WNBA are unknown.

Purpose. To evaluate the details and spectrum of injuries in athletes entering the WNBA combine and to assess the potential effect of specific injuries on the round drafted into the WNBA and career length.

Methods. Demographic data and the documented collegiate injury profile were reviewed from the WNBA database for all players entering the WNBA combine in 2000-2008. The study included injury data on 506 athletes. Complete demographic data were available for 496 players.

Results. Of the athletes taking part in the combine, 45.2% were guards, 33.7% were forwards, and 21.1% were centers. Ankle sprain (47.8% of players), hand injury (20.8%), patellar tendinitis (17.0%), ACL injury (15.0%), meniscus injury (10.5%), stress fracture (7.3%), and concussion (7.1%) were the most common injuries reported. Seventy-three athletes (14.4%) reported ACL reconstruction before entering the WNBA combine, and meniscus surgery was the next most common surgery (n = 50 players; 9.9%). There were no differences in ACL or meniscus surgery when analyzed by player position or round drafted. History of ACL or meniscus surgery did not affect career length in the WNBA. Excluding ACL and meniscus surgery, other reported surgical procedures were knee arthroscopic surgery (11.7%), ankle reconstruction (2.6%), and shoulder stabilization (2.0%).

Conclusion. The ankle is the most common site of injury and ACL reconstruction is the most common surgery in elite female athletes participating in the WNBA combine. A history of injury or surgery did not affect the round drafted or career length.
The First Edition of Sports Injuries: Prevention, Diagnosis, Treatment and Rehabilitation was published in 2011. 2nd edition covers the whole field of sports injuries and is an up-to-date guide for the diagnosis and treatment of the full range of sports injuries. The book pays detailed attention to biomechanics and injury prevention, examines the emerging treatment role of current strategies, and evaluates sports injuries of each part of musculoskeletal system. Publication of the second printed edition edited by Mahmut Nedim Doral, MD, Hacettepe University, Turkey, and Jon Karlsson, MD, University of Gothenburg, Sweden, presenting contributions from leading experts in the field of sports traumatology is planned for 2014, before the ESSKA Meeting in Amsterdam. This extensive reference is currently in development by Springer. Detailed information about the extent of this book project can be found at SpringerReference web page.

To access first edition http://www.springer.com/medicine/book/978-3-642-15629-8
http://sph.sagepub.com/
<table>
<thead>
<tr>
<th>Date Range</th>
<th>Event Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-16 March 2013</td>
<td>Southern Orthopaedic Association (SOA) Southern at the SEC Sports Medicine Symposium</td>
<td>Nashville, TN, USA</td>
</tr>
<tr>
<td>19-23 March 2013</td>
<td>AAOS Annual Meeting</td>
<td>Chicago, USA</td>
</tr>
<tr>
<td>23 March 2013</td>
<td>The American Orthopaedic Society for Sports Medicine (AOSSM) 2013 Specialty Day</td>
<td>Chicago, USA</td>
</tr>
<tr>
<td>3-6 April 2013</td>
<td>5th Congress of the Greek Association of Arthroscopy Knee Surgery and Sports Injuries</td>
<td>Larisa, Greece</td>
</tr>
<tr>
<td>4-6 April 2013</td>
<td>The 10th International Forum on Sports Medicine &amp; Arthroscopic Surgery</td>
<td>Hangzhou, China</td>
</tr>
<tr>
<td>17-19 April 2013</td>
<td>XIV Annual Meeting of the Argentinian Association of Sports Traumatology (AATD)</td>
<td>Caba, Argentina</td>
</tr>
<tr>
<td>18-19 April 2013</td>
<td>15th EFAS Instructional Course</td>
<td>Porto, Portugal</td>
</tr>
<tr>
<td>17-21 April 2013</td>
<td>AMSSM 22nd Annual Meeting</td>
<td>California, USA</td>
</tr>
<tr>
<td>20-22 April 2013</td>
<td>22nd International Conference on Sports Rehabilitation and Traumatology</td>
<td>London, England</td>
</tr>
<tr>
<td>25-27 April 2013</td>
<td>2013 AANA Annual Meeting</td>
<td>San Antonio, USA</td>
</tr>
<tr>
<td>9-11 May 2013</td>
<td>AOSSM Sports Medicine and the NFL: The Playbook for 2013</td>
<td>Boston, USA</td>
</tr>
<tr>
<td>12-16 May 2013</td>
<td>9th Biennial ISAKOS Congress</td>
<td>Toronto, Canada</td>
</tr>
<tr>
<td>29 May – 1 June 2013</td>
<td>XVIII th FESSH Congress</td>
<td>Antalya, Turkey</td>
</tr>
<tr>
<td>5-8 June 2013</td>
<td>14th EFORT Congress</td>
<td>Istanbul, Turkey</td>
</tr>
<tr>
<td>11-14 July 2013</td>
<td>AOSSM 2013 Annual Meeting</td>
<td>Chicago, USA</td>
</tr>
<tr>
<td>12-15 June 2013</td>
<td>San Diego Shoulder Institute 30th Annual Course: Arthroscopy, Arthroplasty, and Fractures</td>
<td>San Diego, USA</td>
</tr>
<tr>
<td>13-14 June 2013</td>
<td>13th Amsterdam Foot and Ankle Course</td>
<td>Amsterdam, Netherlands</td>
</tr>
<tr>
<td>14-15 June 2013</td>
<td>28 Jahrekongress GOTS</td>
<td>Mannheim, Germany</td>
</tr>
<tr>
<td>20-22 June 2013</td>
<td>5th Annual Meeting of Japanese Orthopaedic Society of Knee, Arthroscopy and Sports Medicine</td>
<td>Sapporo, Japan</td>
</tr>
<tr>
<td>26-29 June 2013</td>
<td>18th Annual Congress of European College of Sports Science</td>
<td>Barcelona, Spain</td>
</tr>
<tr>
<td>2 August 2013</td>
<td>International Symposium on Cartilage Repair of the Ankle – Asia 2013</td>
<td>Tokyo, Japan</td>
</tr>
<tr>
<td>9-11 August 2013</td>
<td>3rd INDO-US Shoulder Course</td>
<td>Coimbatore, India</td>
</tr>
<tr>
<td>19-21 September 2013</td>
<td>Anniversary Congress AGA 2013</td>
<td>Wiesbaden, Germany</td>
</tr>
<tr>
<td>25-27 September 2013</td>
<td>4th Balkan Arthroscopy Congress</td>
<td>Novi Sad, Serbia</td>
</tr>
<tr>
<td>25-28 September 2013</td>
<td>13th Asian Federation of Sports Medicine Congress</td>
<td>Kuala Lumpur, Malaysia</td>
</tr>
<tr>
<td>27-28 September 2013</td>
<td>AAOS/POsNA Pediatric Orthopaedics and Sports Medicine</td>
<td>San Diego, USA</td>
</tr>
<tr>
<td>26-28 September 2013</td>
<td>The 8th European Sport Medicine Congress of EFSMA</td>
<td>Strasbourg, France</td>
</tr>
<tr>
<td>13-16 October 2013</td>
<td>8th Combined Meeting of Orthopaedic Research Societies</td>
<td>Venice, Italy</td>
</tr>
<tr>
<td>5-8 December 2013</td>
<td>2013 Advanced Team Physician Course</td>
<td>Las Vegas, USA</td>
</tr>
<tr>
<td>14-17 May 2014</td>
<td>16th ESSKA Congress</td>
<td>Amsterdam, Netherlands</td>
</tr>
</tbody>
</table>
9TH BIENNIAL
ISAKOS CONGRESS 2013
MAY 12–16, 2013 • TORONTO, CANADA
www.isakos.com/2013congress

call for abstracts
TiGenix focuses on applying regenerative medicine to damaged and diseased joints with the goal of developing durable treatments, validated through controlled clinical trials.

ChondroCelect®, the company's lead product for cartilage repair in the knee, received the European Marketing Authorisation on October 5, 2009 as the first centrally authorised Advanced Therapy Medicinal Product (ATMP). The product is a suspension of characterised viable autologous cartilage cells expanded ex vivo and expressing specific marker proteins.

www.tigenix.com
NAME OF THE MEDICINAL PRODUCT: ChondroCelect 10,000 cells/microlitre implantation suspension. QUALITATIVE AND QUANTITATIVE COMPOSITION: General description: Characterized viable autologous cartilage cells expanded \textit{ex vivo} expressing specific marker proteins. Qualitative and quantitative composition: Each vial of product contains 4 million autologous human cartilage cells in 0.4 ml cell suspension, corresponding to a concentration of 10,000 cells/microlitre. PHARMACEUTICAL FORM: Implantation suspension. Before re-suspension the cells are settled to the bottom of the container forming an off-white layer and the excipient is a clear colourless liquid. Therapeutic indications: Repair of single symptomatic cartilage defects of the femoral condyle of the knee (International Cartilage Repair Society [ICRS] grade III or IV) in adults. Concomitant asymptomatic cartilage lesions (ICRS grade I or II) might be present. Demonstration of efficacy is based on a randomized controlled trial evaluating the efficacy of ChondroCelect in patients with lesions between 1-5cm². Posology and method of administration: ChondroCelect must be administered by an appropriately qualified surgeon and is restricted to hospital use only. ChondroCelect is solely intended for autologous use and should be administered in conjunction with debridement (preparation of the defect bed), a physical seal of the lesion (placement of a biological membrane, preferentially a collagen membrane) and rehabilitation. Posology: The amount of cells to be administered is dependent on the size (surface in cm²) of the cartilage defect. Each product contains an individual treatment dose with sufficient number of cells to treat the pre-defined lesion size, as measured at biopsy procurement. The recommended dose of ChondroCelect is 0.8 to 1 million cells/cm², corresponding with 80 to 100 microlitre of product/cm² of defect. Method of administration: ChondroCelect is intended solely for use in autologous cartilage repair and is administered to patients in an Autologous Chondrocyte Implantation procedure (ACI). The implantation should be followed by an appropriate rehabilitation schedule for approximately one year, as recommended by the physician. Contraindications: Hypersensitivity to any of the excipients or to bovine serum. ChondroCelect must not be used in case of advanced osteoarthritis of the knee. Undesirable effects: In a randomized, controlled study in the target population, 51 patients were treated with ChondroCelect. In these patients, a periosteal flap was used to secure the implant. Adverse reactions occurred in 78.4% of the patients over a 36-months postoperative follow-up period. The most common adverse reactions were arthralgia (47.1%), cartilage hypertrophy (27.4%), joint crepitation (17.6%) and joint swelling (13.7%). Adverse reactions collected from 370 patients included in a Compassionate Use Program are similar to those reported in the target population. Most of the reported adverse reactions were expected as related to the open-knee surgical procedure. The most frequently occurring reactions reported immediately after surgery include joint swelling, arthralgia and pyrexia. These were generally mild and disappeared in the weeks following surgery. Adverse reactions of special interest: Arthrofibrosis: In the compassionate use patients, a higher incidence of arthrofibrosis and decreased joint range of motion was observed in a subgroup of patients with a patellar lesion (8.2% and 13.1% respectively) compared to non-patellar lesions (0.6% and 2.6% respectively). Cartilage hypertrophy: In the majority of the 370 patients included in the Compassionate Use Program, a collagen membrane instead of a periosteal flap was used to seal the defect. According to current literature the incidence of cartilage hypertrophy can be reduced by using a collagen membrane to cover the lesion site instead of using a periosteal flap (Gooding \textit{et al.}, 2006; Niemeyer \textit{et al.}, 2008). When a collagen membrane was used to seal the lesion site after application of ChondroCelect, the incidence of cartilage hypertrophy was reported to be 1.8% compared to 25% in the randomized, controlled trial alone. Name of the MA holder: TiGenix NV, Romeinse straat 12/2, B-3001 LEUVEN, Belgium. Product authorization number: EU/1/09/563/001. Medicinal product to restricted medical prescription – restricted to hospital use only.
Our focus is on one-step cartilage repair

The TRUFIT® CB Plug from Smith & Nephew is a purely synthetic scaffold designed for the treatment of isolated cartilage defects. The hydrophilic and porous attributes of this implant encourage migration of marrow cells from the subchondral bone layer to the repair site, as well as support the growth of healthy cartilage cells for tissue healing and regeneration. Two-year patient follow-up data shows progressive maturation of the repair tissue, and T2 mapping scores of the new cartilage approach the values of native cartilage.\(^1\)\(^2\)

\(^1\) A. Bedi, LT. Fox, J. Williams, and RD. Potter. "Assessment of Synthetic Scaffolds for Osteochondral Donor Sites of the Knee Using Cartilage - Sensitivity and T2 Mapping MRI." *JMRS* 2000. Poster D01.

Privileged Partners

DJO GLOBAL
STRYKER
MITEK - DE PUY
SMITH - NEPHEW