AO Foundation

AODIALOGUE

The magazine for the AO community 2 / 07

Community zone

Computer-Assisted Surgery

Focus on the growing partnership between AO Foundation and BrainLAB

Expert zone

AO Clinical Investigation Department

An insight into AO's worldwide clinical research

AODIALOGUE

Computer-assisted surgery.

Read more in the community zone.

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Editorial

James F Kellam
Editor-in-Chief

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While visiting Gunther Von Hagens' BODY WORLDS, an exhibition that shows the human body through the technique of plastination, I was explaining to my son the various anatomical exposures that an orthopedic surgeon does to perform fracture surgery or total joint replacement. He was amazed that bones and joints could be exposed to implant fracture implants and joint replacements by these carefully done surgical approaches, yet allow the extremity to return to excellent function. This response made me think of the responsibility entrusted to us as surgeons by society and more importantly, our individual patients. We are expected to respect the human body while at the same time perform surgical techniques which violate the integrity of the soft tissues and bone. We are trained to do these procedures while at all times recognizing the responsibility to perform them correctly and to the best of our abilities. It also brought home the responsibility that an organization such as the AO Foundation has. The Foundation is a group of surgeons who are striving to perfect and improve the treatment of musculoskeletal injury and disease through operative care. The same responsibility that has been given to each of us as an individual surgeon is given to the AO Foundation collectively. It is the Foundation's mission to develop new techniques, new implants and new concepts to meet the clinical needs of our patients. Therefore, we as the Foundation must respect this responsibility and assure ourselves, society and our patients that we are living up to this responsibility.

This issue will demonstrate how the Foundation ensures that this is the case. Christian Krettek and his Computer-Assisted Surgery Expert Group have taken on the task of investigating the role of computer-aided surgery in orthopedic trauma and reconstructive surgery. These individuals and their group working under the Technical Commission guidelines have now developed systems that will help us understand where computer-assisted surgery will be of benefit. In order for these developments to be successful, collaboration with computer software experts was necessary. This has been possible through the cooperation of Stefan Vilsmeier and Claus Schaffrath of BrainLAB. They have guided their company and their support to meet the standards of AO development and education. The introduction of computer-assisted surgery will be done in a responsible manner, so that we as surgeons will know where it is best applied.

Understanding what the impact of our new implants and techniques has on patients is a responsibility that the Foundation takes seriously. It is quite easy to develop a new implant or technique and release it on the market after it has met the minimum standards of the regulatory bodies. The AOCID under the direction of Beate Hanson and David Helfet assure us that we know clinically what these results are. The expert zone of this issue has several articles showing how clinicians and clinical health care researchers have worked together to produce results that inform us of what is happening with our implants and in fact have come up with some new innovative ideas which are clinically helpful. This type of collaborative endeavor to do the best evidence-based clinical surgical research possible assures that the AO Foundation can stand behind its developments knowing that our responsibility to patients and society has been met.

With these areas, the Foundation will live up to its responsibility to society to provide the best possible solutions for the improvement of operative care of the musculoskeletal disease and injury.

AO Research Fund Prize Award 2007

Project title: Introduction of articular chondrocytes overexpressing recombinant human BMP-2, IGF-I and FGF-2 genes to osteochondral defects
Winner: Henning Madry

Adrian Sugar and Henning Madry

Henning Madry
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The second AORF Prize Award was presented to PD Dr Henning Madry, a clinician and researcher from Homburg, Germany, by Adrian Sugar at the Trustees Meeting in China. His excellent project was selected over 22 other entries by the awarding committee. The award also came with a check for 10,000 Swiss Francs. Dr Madry said, "I am very happy to receive such a high honor. It's been a privilege for our laboratory to be supported by the AO Research Fund."

Our work focuses on the development of gene-based approaches to enhance the repair of focal traumatic cartilage defects. The underlying problem is the fact that articular cartilage lesions do not heal and may lead to the development of osteoarthritis. An experimental approach to enhance the quality of the repair tissue that forms in such defects, eg, as a result of marrow-stimulating techniques such as microfracturing, is the application of growth factors. These polypeptide growth factors are increasing the rate of cell division and synthesis of extracellular matrix proteins and stimulate the repair of articular cartilage defects in vivo. Their potential to treat articular cartilage defects is reduced, however, due to their short intraarticular half-life. This problem is further complicated by the intrinsic paucity of cells within the defect. Our idea was to apply gene transfer techniques in order to deliver such factors directly and persistently to cartilage defects. Gene transfer (also termed transfection or transduction) is the introduction of foreign genes or gene sequences into somatic cells, while gene therapy refers to the treatment of a disease by using the method of gene transfer. We aimed at introducing therapeutic gene sequences into articular chondrocytes which were later transplanted into articular cartilage defects. These modified chondrocytes are thought to serve the dual role to both fill the defect and to secrete a specific chondrogenic factor for a prolonged period of time that specifically stimulates repair. In the work that was funded by the AO, we studied the overexpression of growth factors genes in articular cartilage defects.

After optimizing experimental parameters such as transfection conditions, we transplanted chondrocytes modified with a marker gene that were encapsulated in alginate in osteochondral defects in the patellar groove of rabbits. The transferred gene was active for about one month, a duration of gene expression that is relevant for a therapeutic gene to enhance articular cartilage repair. We next tested the hypothesis that overexpression of a human insulin-like growth factor I (IGF-I) cDNA enhances repair of these defects. At three and fourteen weeks postoperatively, articular cartilage repair was significantly improved for defects treated with alginate spheres containing IGF-I-transfected chondrocytes compared to alginate spheres containing marker-gene modified chondrocytes. A similar study was performed using fibroblast growth factor 2 (FGF-2). FGF-2 is known to enhance cell proliferation and to stimulate chondrogenesis. The results of this study demonstrate that localized overexpression of a human FGF-2 gene sequence augments chondrogenesis and enhances articular cartilage repair in vivo, without adverse effects on the synovial membrane. These data might be used to define the effects of potential chondrogenic genes on articular cartilage repair in vivo. In addition, they might lead to the development of novel gene-based therapies for traumatic focal articular cartilage defects. Current research evaluates the long-term properties of this repair tissue in a large animal model.

Data from these studies have been presented as abstracts at the Annual Meetings of the Orthopaedic Research Society and have been summarized in three MEDLINE-listed publications. We wish to thank the AO Foundation for their constant support of our studies.

New AOE Fellowship and Visiting Professorship Program for Computer-Assisted Surgery (CAS)

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For many years AO Education has been offering the opportunity to interested general trauma, CMF, orthopedic, and veterinary surgeons to participate in a Fellowship for 6–8 weeks. Around the world over 120 specially selected units host this program and offer advanced training in the operative treatment for musculoskeletal injuries and diseases and their late sequela. Up until 2006, about 5,600 surgeons had participated in this program.

To keep abreast of recent developments, and to ensure new technology knowledge transfer, AOE together with BrainLAB have decided to offer six Fellowships per year in the field of computer-assisted surgery (CAS) to surgeons from Asia Pacific, North and Latin America, and Europe. These Fellowships are offered by centers which already have special experience with CAS and use this technique in daily practice.

The CAS Fellowship is 8 weeks in length and applicants should have extensive surgical experience, as well as the possibility to use this newly acquired knowledge in their practice.

For AO members who already have a navigation system from BrainLAB, but would like to take advantage of the experience and practical help of a CAS specialist in their unit, AOE offers a Visiting Professorship. This program provides funding for a CAS specialist to visit your unit for a few days to offer theoretical as well as practical support. For further information, interested surgeons are invited to contact AO Education at: fellowship@aofoundation.org.

Some of the many AO fellows worldwide.

AO approves 3 CAS modules

An interview with Stefan Vilsmeier, CEO of industrial partner BrainLAB, and Professor Christian Krettek, Chairman of the AO CAS Expert Group by Diarmuid De Faoite, Editor, AO Foundation, Communications and Events.

What are the main clinical advantages of the new CAS modules for patient treatment?

Professor Christian Krettek (**CK**): The clinical advantages of navigation include highly accurate intra-operative imaging and measurement. It allows for precise reduction in femur fractures and for precise implant positioning in spine/pelvic and femur fractures to be carried out. High tibial osteotomies can also be done to within 1 mm/1° accuracy.

Navigation is a standard tool in neurosurgery and will be in trauma surgery. Furthermore, certain operations can only be done using CAS (eg, pelvic tumors and certain circumstances in pelvic ring fractures like obesity and bowel gas).

It is essential for the AO Foundation, as the worldwide leading independent organization in skeletal trauma, to become a leader in CAS too. CAS technology will also help the AO Foundation to maintain and strengthen its leadership position.

> "Navigation is a standard tool in neurosurgery and will be in trauma surgery."

What do the new CAS modules mean for surgeons?

Stefan Vilsmeier (**SV**): Surgeons can now obtain valid education through the AO CAS course modules. The courses are designed to explain the principles of CAS treatment in trauma and to prepare surgeons for clinically relevant problems where they can apply CAS in a standardized way.

Learning more about these standards helps the trauma surgeon to apply navigation in a broad range of cases. CAS courses also help to facilitate trauma CAS 'market adoption' in general.

What does "development under medical guidance" mean?

CK: In the AO Computer-Assisted Surgery Expert Group (CSEG), there is a quite unique cooperation between researchers, implant engineers, and now the software producer and surgeons have come on board. "Development under medical guidance" means that it is the clinicians who steer the process.

Christian Krettek, Chairman CSEG

The TK system is about contributing to and ensuring the clinical benefit of recommended products. Can you explain how this has been accomplished with the CAS modules?

CK: The clinical benefit of a module is analyzed according to the specific needs of the anatomical structure involved, but also according to the caseload or frequency of clinical applications. For example, the module 'SPINE' was already developed by BrainLAB, but needed to be adapted to Synthes products and was verified in a clinical study. The SI-Screw and the Femoral Reduction modules underwent cadaver and clinical tests, but not a clinical study. High Tibial Osteotomy (HTO) is a frequently used, very standardized surgical technique with a high caseload. Therefore, after cadaver and clinical handling tests it could be tested in a prospective randomized clinical study.

All modules are first tested in only two selected centers, then in all the CSEG clinics. The results and performance are discussed before TK approval is finally requested.

What were the biggest challenges faced during the development process?

SV: The AO Foundation's CSEG set high standards which we had to meet. A lot of work went into developing the modules. An enormous amount of programming work went into even reaching the prototype stage.

CK: From my point of view, the biggest challenges we faced—and still face—were understanding each other's 'language', as well as adapting the priorities and expectations from the surgeons, the implant producer Synthes, and the software producer BrainLAB. Due to the necessary transition period from the former navigation company Medivision to BrainLAB, the development of certain modules such as the reduction and nailing module took longer than initially planned. However, we are still ahead of our competitors in the area of development.

"The 'digital hospital' is something that is very much talked about among hospital administrators."

What does the market for CAS look like?

SV: CAS is already used in many different areas of surgery so luckily BrainLAB does not face the challenge of having to introduce a totally new concept to people. Indeed, the 'digital hospital' is something that is very much talked about among hospital administrators.

Smaller hospitals might refrain from purchasing a standalone trauma navigation system for cost reasons. It is possible to increase cost effectiveness by integrating BrainLAB modules into existing CAS systems from other departments, or to combine trauma CAS with other orthopedic applications.

It is exciting to be part of establishing and supplying this new digital market for hospitals.

Stefan Vilsmeier, CEO BrainLAB

Are there any cultural issues to consider?

CK: Historically, computer navigation in the field of orthopedic trauma began in Europe with a small group of enthusiastic pioneering surgeons from Germany and Switzerland and was mainly developed there.

Surgeons in North America had less flexibility to carry out pioneering work. But the situation has changed for the better, and with the new industrial partner BrainLAB, any initial technical problems have been solved or significantly reduced. In the meantime, there are a few centers in North America like Dr Kahler's hospital where computer navigated procedures have been used in routine cases for several years.

North American interest in computer navigation is growing and we are conscious that there are cultural differences around the world on how to deal with an orthopedic trauma problem. Such concerns are being addressed by the North American subgroup which will help to better meet their specific needs in both clinical applications and teaching. It will be interesting to see if the North American medicolegal climate (femoral shaft fractures are the number one cause of medicolegal litigation [ie, leg length discrepancies, femoral malrotation]) will have an impact on the use of navigation as it is able to provide accuracy to within 1 mm and 1°.

What will it take to make CAS a standard application in trauma surgery?

CK: I believe it is crucial to improve six things:

- Setting up a navigation system must be as easy as rolling in and turning on a C-arm.
- In tracking fragments with so called dynamic reference bases (DRBs) connected to bone fragments, instruments, implants, and the C-arm, the simultaneous visibility of the CAS camera (a line of sight problem) is sometimes difficult to achieve and time consuming.
- The precision and performance of the system is strongly dependent on a reliable and constant fixation of the DRB to the bone. Accidental mechanical stress caused by either the surgical team or the soft tissues during movements, especially in osteoporotic bone, are additional challenges and risks which need to be lowered in the future.
- Despite the fact that a lot has already been achieved, the man-machine interface needs to be even more intuitive, guiding the surgeon through procedures, giving him or her hints, and allowing variations of certain actions.
- Since CAS is so new, the level of evidence compared to other technologies is not yet very high and prospective randomized tri-

als are rare. However, these trials are needed to help convince surgeons, hospital management, and health care providers of the benefits CAS can bring.
- The cost of investing in hardware and software along with maintenance costs needs to be reduced. There is a significant link between these costs and the number of systems sold on the market.

The vision is to prove that we can reduce the risk for revisions (which increases OR time and length of stay) and medicolegal problems. These extra costs due to a lack of CAS technology need to be calculated against the cost of having a CAS system. It is only a question of time until in medicolegal litigation the question is asked, "...and why did the surgeon not use computer navigation?"

"Trials are needed to help convince surgeons, hospital management, and health care providers of the benefits CAS can bring."

What is your strategy regarding support of instruments and implants produced by other industrial partners?
SV: Integration with other industrial partners' products is important and is something that BrainLAB has always practiced. We see no reason to change our strategy of ensuring integration with other industrial partners' products as this is something which helps ease the acceptance and adoption of the BrainLAB output.

Given the huge advances we see in computer technology every year, is there not the danger that hospitals could be saddled with expensive, outdated CAS equipment?
CK: I'm not so pessimistic. Who would have thought 20 years ago that a C-arm-Mini CT costing €250,000 would be used in so many operating rooms? I suspect that ten years from now a navigation system will become as normal as an image intensifier in the OR. But for now I believe that:
- For a 'normal' institution with a significant number of patients with certain diagnoses the existing modules can be used for years (However, software replacement after 5-6 years must be taken into account).
- The shared use of a system by several departments helps to lower costs.
- I'm quite sure that investment costs will decrease in the future.
- Bundling with implant costs could be an avenue worth exploring. This is already done in the non-trauma arthroplasty market and could potentially be adapted for the trauma segment.

SV: This is a question being debated in the world at large. There are always improvements in both infrastructure and know-how. It is often not necessary to completely replace infrastructure, certain components can be exchanged and software updates can be made available. Buying CAS equipment should be seen as a mid-term investment. In the 18 years of the existence of BrainLAB we have built up very good relationships with our customers and our goal is to maintain this level of trust.

In which countries are BrainLAB currently offering the CAS modules?
SV: With the exception of the USA, they have been offered all around the world.

What are the next key developments for CAS in trauma you are currently working on?
SV: Better integration of products and implants. This will depend on what solutions are on offer and what it is possible to offer. Areas of treatment in sports medicine such as cruciate ligament injuries are obviously ripe for further development.
CK: Reduction is THE core topic in orthopedic trauma. With the existing reduction module, we are able to control and reduce alignment, so it is mainly for extraarticular fractures by defining six degrees of freedom or clinically speaking length, rotation, and frontal/sagittal plane alignment. But the reduction problem of intraarticular fractures to achieve a step free, anatomically reduced articular surface is not yet solved. So the biggest priority and the next key development will be the computer navigated reduction of intraarticular fractures.

What are the next steps in this cooperation?
CK: After setting up the structures and protocols during the first few years of cooperation, the next steps will be to fill these with life, especially in the four key fields of research, development, quality control, and teaching. Besides the developmental research, the clinical side with high level evidence and economical research will be crucial.

SV: First, it is important to ensure that the developed modules are kept to the high standard they currently are. Second, we will take these pioneering modules and use them as a stepping stone to improve future modules so that every AO surgeon who goes on a CAS module can extract maximum benefit from it.

AOSpine Access and Navigation Expert Group

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After the TK system was subdivided in three specialties, the Access and Navigation Expert Group (ANEG) of AOSpine started its work in August 2005. Currently, the ANEG consists of 5 members: Roger Hartl (New York), Frank Kandziora (Berlin, Chairman), Andreas Korge (Munich), Khai Lam (London) and Jeffrey Wang (Los Angeles). The main working area of the ANEG is spinal navigation, minimal invasive spine surgery and access technology. The combination of these working areas is ideal, because the less invasive spine surgery becomes, the less direct visualization of the operative field is possible and the more important navigation technology becomes. In the past, several substantial developments like the MIRA (Minimal Invasive Retractor Access System), the ProAccess System and the MIS Support System, which are in the meantime widely used in minimal invasive spine surgery all over the world, were passed by the ANEG.

Currently, the ANEG focuses on the development of a percutaneous and a minimal invasive posterior pedicle screw stabilization system for degenerative lumbar spine disorders. A very important part of this development is the combination of minimal invasive screw systems with navigation technology, not only for pedicle screw application but also for navigated removal of disc material. Therefore, the ANEG is running one in vitro experimental and one clinical study, together with our industrial partners and the AO Clinical Investigation and Documentation Department (AOCID), to evaluate the clinical potential of these new navigation based developments. A very important step in this context was that the ANEG approved the Surgical Spine Module of BrainLab in March 2007 and passed it over to the AOSpine TK for final approval. The Surgical Spine Module includes options for CT based and fluoroscopic spinal navigation as well as intraoperative planning and navigation of points and trajectories.

Navigation technology is becoming more important in spine surgery.

In future, the ANEG will focus on the development of a large variety of navigatable instruments for minimal invasive spine surgery, soft tissue navigation in spine surgery, and navigated spinal osteotomies. However, the most important project for the future will be the development of an integrated minimal invasive access and navigation technology for noninstrumented spine surgery.

Frank Kandziora, Chairman ANEG

Comprehensive Expert Group

Craniomaxillofacial surgery is just one area of medicine which has benefitted from advances in computer technology. Read how the AO Foundation keeps abreast of these developments.

Rainer Schmelzeisen, Chairman COEG

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Computer technology has been utilized in CMF surgery for quite a while now. Besides the improved ways of accurate positioning of implants during the operation, there are in fact two more aspects in computer-assisted surgery (CAS) that are of great importance in CMF. First, the new technologies allow for a precise preoperative planning procedure; second, CAS serves as an unrivaled quality control instrument postoperatively with great teaching quality.

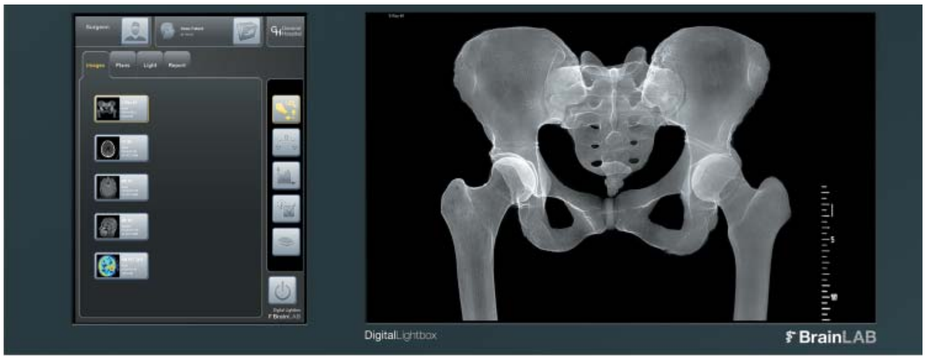
Since its inauguration in early 2005, the Comprehensive Expert Group (COEG) develops CAS technologies especially for craniomaxillofacial surgeons. Among this group's various projects is a new tool for preoperative planning of CMF procedures. Even in cases of complex trauma the surgeon will now be able to establish a complete restoration plan by using software tools to mirror the unaffected side of the face onto the damaged side, giving clear landmarks in distances, relationships, and projections to serve as the blueprint for the operation. If older image data of the patient is available this will even be possible in cases where both sides of the facial bone structure are damaged.

The group also works on improved ways of digital imaging and communications in medicine (DICOM), data segmentation as well as new hardware for intraoperative navigation. Also having the developments on the hardware side in focus, it will be another major task for the COEG to coordinate the use of planning and navigation modules with new and improved intraoperative imaging technologies such as the C-arm. The medical COEG members are Rainer Schmelzeisen (Freiburg, Chairman), Edward Bradley Strong (Davis), Thiam Chye Lim (Singapore), and Hans-Florian Zeilhofer (Basel), representing the three big specialties that make up CMF surgery: oral surgery, plastic surgery, and otolaryngology.

> "The new technologies allow for a precise preoperative planning procedure."

BrainLAB behind the scenes

A rewarding cooperation: BrainLAB and the AO



The Digital Lightbox (will be available in early 2008).

Claus Schaffrath
Marketing Director
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When we took the first steps on our partnership between the AO and BrainLAB almost three years ago, I never imagined that this was the beginning of a journey, which has had an ever increasing impact not only on our perception of trauma care and related field, but also on training and educating health care professionals in new technologies. Right from the start we found the support and willingness to cooperate in various areas, from the excellent and open-minded exchange on development with the Computer Surgery Expert Group (CSEG) and ADI, studies with AOCID and mutual work with AO Education and Publishing. Also in our interactions on AO courses around the world—be it in America, Asia, or Europe—we found ourselves welcomed as a readily accepted member of the AO family.

Partnering with the AO network of healthcare professionals in 2004 marked a new era for BrainLAB—which was founded by our CEO Stefan Vilsmeier in 1989 and quickly became a leading innovator of software solutions for today's clinical challenges. Our mission ever since has been to bridge the gap between the high quality of preoperative imaging and reality in the OR.

BrainLAB kicked it off with navigation software for neurosurgery as its first product. Over the last 15 years, navigation has become standard for many specialties, enabling surgeons to treat patients with greater accuracy. BrainLAB has continued to pioneer new developments in the field of radiotherapy and computer-assisted surgery (CAS) in neurosurgery, orthopedic, trauma, spine, ENT, and CMF surgery.

Today, more than 200 research and development engineers of the around 1,000 BrainLAB employees worldwide are continuously striving to take technology to the next level. BrainLAB technology can be found in more than 2,000 ORs in the world, where numerous surgeons today use CAS to increase precision during surgery. After more than 15 years of expertise in the development of image-guided technologies, BrainLAB is now also focusing on integration and the effective managing of medical data.

AO principles of fracture care, preoperative diagnosis and surgical decision-making play a crucial role in identifying the appropriate surgical steps. The link between imaging, planning and intraoperative execution has always been key to BrainLAB products.

This can be seen in the AOTK approved CAS modules, which we developed together with the CSEG, but also in developments like the Digital Lightbox, an interactive multimodality image and data system which combines the benefits of traditional hospital lightboxes and modern viewing workstations. Two intuitive touchscreens make it easy and convenient to manipulate and modify images to suit clinical needs, and bring static digital medical information to life.

Working with the AO over the past years has been great and kept us in touch with the AO spirit, in which we found a good match to our company values of innovation, integrity, and fun. Our mutual past achievements to advance patient care in trauma with computer-assisted surgery has reached its first milestone. The journey goes on—together.

AOSpine subscription membership launch

Taking AOSpine to a new level

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AOSpine has recently gone through a revolutionary change—the launch of a subscription based membership program. Over the past few years AOSpine has introduced an increasing array of services and benefits, which were so far free of charge to registered members. Now an extended range of products and services are available to subscribing members only. The new member fees will fund the creation of further products and services and will support the five AOSpine regional organizations to address the needs of their local member communities.

AOSpine is the world's largest spine community, with over 6,000 members, all of who enjoy a host of opportunities for sharing experiences and profiting from each other's know-how.

> "For me AOSpine is about people from diverse backgrounds sharing ideas and experiences."
> *Teija Lund, Finland*

The community is open to all, from a resident starting out in his/her medical career to master spine surgeons (irrespective of their commercial affiliations) who are prepared to share their experience and know-how... AOSpine welcomes everyone interested in improving the outcome and effectiveness of spine surgery!

Access to a unique global community

Membership of AOSpine is the "right of access" to the world's largest spine community—a worldwide platform that delivers real and tangible benefits to its members.

> "Whether we were trained in North America, Europe, or here in the Middle East, we know we all benefit from being part of AOSpine's unique global network."
> *Magdy Gamal, Egypt*

Members choose what they value

AOSpine recognizes that different members have different needs so it has taken a novel approach, providing a menu of packages allowing members to choose what they value.

- Premium members: receive AOSpine journals, magazines, DVDs, etc by postal mail and in electronic format.
- eMembers: receive AOSpine journals, magazines, DVDs, etc in electronic format only (downloads).

Members pick and choose from five different benefits packages (**Fig 1**).
For more information on these packages and fees please visit the new AOSpine website www.aospine.org

> "I would like to congratulate the AOSpine International Board for their splendid work! I've been a spine surgeon for many years and I'm pleased to say that AOSpine is delivering products and services that offer real value to me."
> *Tomasz Trojanowski, Poland*

Membership progression

AOSpine follows a simple, transparent system of membership progression—BRONZE, SILVER, GOLD, PLATINUM (**Fig 2**).

Full benefit ■ / Teaser benefit ▨	Associates	Package 1 eMembers	Package 1 Premium Members	Package 2 eMembers	Package 2 Premium Members	Package 3 eMembers	Package 3 Premium Members	Package 4 eMembers	Package 4 Premium Members	Package 5 eMembers	Package 5 Premium Members
European Spine Journal (online)										■	■
Hard-copy DVD 1 pa									■		■
OVID				■	■			■	■	■	■
SpineLine				■	■	■	■	■	■	■	■
Live Surgery	▨	▨	▨	▨	▨	■	■	■	■	■	■
Lectures	▨	▨	▨	▨	▨	■	■	■	■	■	■
Teaching Videos	▨	▨	▨	■	■	■	■	■	■	■	■
EBSS online (1) / printed (2)	▨	▨	▨	1	1, 2	1	1, 2	1	1, 2	1	1, 2
People Finder		■	■	■	■	■	■	■	■	■	■
Partner discounts		■	■	■	■	■	■	■	■	■	■
AOSpine discounts		■	■	■	■	■	■	■	■	■	■
AOSpine Passport		■	■	■	■	■	■	■	■	■	■
Membership Card		■	■	■	■	■	■	■	■	■	■
myAOSpine online (1) / printed (2)	▨	1	1, 2	1	1, 2	1	1, 2	1	1, 2	1	1, 2
InSpine online (1) / printed (2)	▨	1	1, 2	1	1, 2	1	1, 2	1	1, 2	1	1, 2
Member directory	▨	■	■	■	■	■	■	■	■	■	■
Interactive Case Studies (online)	▨	■	■	■	■	■	■	■	■	■	■
eNewsletter	■	■	■	■	■	■	■	■	■	■	■
Membership ID	■										

Fig 1 Membership packages

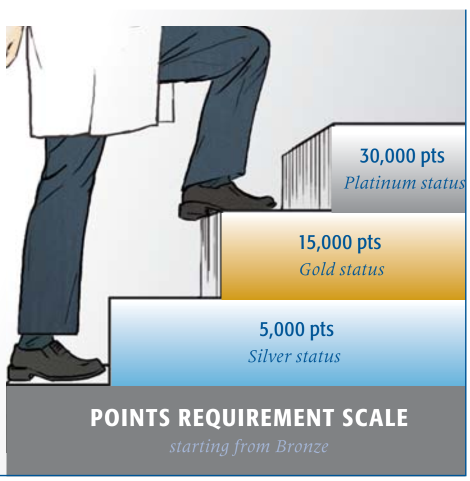

Fig 2 Membership progression

Every position or activity within AOSpine is assigned a defined points value. Members earn points by, for example:

- Supplying an interactive case study
- Acting as a mentor in a forum
- Lecturing at a course
- Providing an article for an AOSpine journal

> "The 'new' AOSpine uses transparent and inclusive practices as it delivers unique and valuable services to its membership."
> *Alex Vaccaro, USA*

Members who get involved in the community are entitled to further rewards and opportunities, such as preferential discounts on AOSpine products and services and exclusive offers. Those who reach Platinum status have clearly given a lot of time, energy, and commitment to the organization. This dedication deserves particular recognition and should open new doors. Platinum status consequently represents a qualification to stand for election for a position on an AOSpine Board, Commission, or Committee etc.

Last but not least, AOSpine is, and will remain a fun and enjoyable social network, where like-minded professionals can get together at AOSpine courses and events, or take refuge in an AOSpine lounge at a busy congress and catch up with colleagues. That's what being a member of AOSpine is about!

> "Since joining I have made friends in 5 continents."
> *Kenneth Cheung, Hong Kong*

Fortifying the AO Spirit
The 2007 Trustees Meeting held in Beijing, China.

The Shangri-La Hotel in the bustling city of Beijing, China, was the venue for the AO Foundation's Board of Trustees Meeting from June 6 to June 9, 2007. Approximately 140 Trustees along with their spouses and guests arrived from all over the world to one of the most successful meetings yet.

Communications and Events
AO Foundation

communications@aofoundation.org

Wednesday, June 6
Those Trustees who had already arrived in Beijing were able to mingle and renew old friendships at the evening welcome dinner.

Thursday, June 7
After the traditional introduction of new Trustees there was a formal welcome by Chris van der Werken, the President of the AO Foundation, and a more local welcome made by Chinese Trustee Manyi Wang. He went on to make an impressive speech, accompanied by a very talented Chinese sand artist whose unique pictures made the perfect backdrop. The Trustees were given an orientation on health care in China and Asia by Kerong Dai and Frankie Leung. The various Clinical Priority Programs were then highlighted, with the parallel sessions allowing for a greater focus on the individual programs.

Gregor Strasser, the AO Foundation's CEO, made very interesting presentations which highlighted the AO's current state and future plans. Particularly impressive is the growth in the number of countries with AO organizations (sections, chapters) over the past four years. From approximately 40 countries in 2002, this figure had increased by more than a third to roughly 60 countries by 2006. Providing appropriate support structures and services for these burgeoning areas of activity is an obvious priority.

The number of AO courses organized worldwide continues to grow with more than 450 on offer in 2007. As recently as 2004 the total number was 300. Ensuring the quality of these courses, making the courses CME compliant as well as tailored to the participants' needs are the main areas currently exercising AO Education.

Jim Kellam outlined how AO/AO Alumni membership has grown by 32% within the past four years but there is also significant 'member turnover' which needs to be addressed. Management of AO membership is a burning issue within the AO which needs careful handling to achieve the twin goals of fostering the network and sharing the amazing amount of knowledge available. Careful tending of the membership should also achieve the strategic goal of maintaining the AO's standing as the most attractive community in trauma and musculoskeletal surgery.

Chris van der Werken elaborates, "a new, more transparent membership concept is currently under consideration. In line with the AOSpine model, it will offer clear opportunities for those interested in planning an AO career. By being transparent it will offer tangible prospects and clear value for money. I expect that a decision on how exactly to proceed with this membership concept will be made in December 2007."

The bulk of the afternoon was taken up by the General Assembly which was attended with great interest by the Trustees. A presentation on Schatzalp 1—the name given to the AO Foundation's current project to define and develop strategic research goals—was given by Gregor Strasser. Interviews with stakeholders and the teasing out of the identified options are the steps which will be taken in the near future. The project is still in development and a detailed concept outlining the consequences to the AO's research

"A successful Trustees Meeting strengthens the organization as a whole."

strategy, processes, and the organization itself will be completed by the end of 2007 for submission to the Board of Directors (AOVA).

The day was rounded off with a trip on "dragon boats" at the Kunming Lake to the Ting Li restaurant in the Summer Palace later that night for the evening meal.

Friday, June 8

Some Trustees took advantage of the Tai Chi class offered very early in the morning as the ideal way to prepare themselves for a long day of meetings. The first part of the morning dealt with the topic of 'From Clinical Problem to Solution,' a section moderated by Stephan Perren.

The parallel breakout sessions later that morning focused on elements of the Clinical Priority Programs and a spine master class was also held. Before breaking for lunch, Mr Adrian Sugar presented Henning Madry with the AO Research Fund Prize Award.

The afternoon was set aside to allow the Trustees to hold face to face meetings and thereby to profit from the concentration of expertise in one location.

For many, that evening's trip to climb the Great Wall of China and to dine on one of its lower levels will remain an extraordinary memory for the rest of their lives.

Saturday, June 9

The Trustees were confronted early on Saturday morning with the very relevant areas of the AO Foundation's strategy and priorities. Several directors of AO institutes highlighted how these issues manifest themselves within their institutes.

Biotechnology in knee surgery was the focus of the next part of the meeting. Wang Hui then lent the affair a local flavor with his summation of doing business in China.

The closing formalities were of course ably carried out by Chris van der Werken. The Trustees final social outing was to the very impressive Forbidden City and to Tiananmen Square.

The consensus at the end of the meeting was that it was a long way for many to travel, but more than worth it for the value of the scientific program and networking possibilities. This sentiment was reflected in the Chinese proverb on the bag given to each Trustee—"it's a small world after all." The assembled Trustees from every corner of the globe were testimony to the truth of this.

One week later back in Europe, Chris van der Werken reflected upon the events in China. "I am very pleased with how the Trustees Meeting went. It ticked all the boxes one would expect for a successful meeting—harmonious, challenging, constructive, and of course, enjoyable. It was very rewarding for me personally that it all went so well as I am accountable to the Trustees. Having a successful Trustees Meeting strengthens the organization as a whole as it contributes to the famous 'AO Spirit.' It was also pleasing to see a good social mixing of all the participants, regardless of specialty or geographic region and so on."

The next Trustees Meeting will be held in Davos, Switzerland, in 2008. As next year is the 50th anniversary of the AO Foundation it promises to be something very special.

The Biotechnology Advisory Board, BAB and its changing role in the AO Foundation

Advisory boards provide expertise which complements that of the group asking their advice. In most cases these experts are part of a larger network which may further support such consultancy activities with additional know-how.

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AO meeting future needs: harnessing the technology of the future

The AO Foundation has a unique well coordinated worldwide network of actively practicing clinicians who are dedicated to the development of solutions for various treatment problems for injury and disease of the musculoskeletal system. The Academic Council (AcC) serves as an advisory board to assure that the AO Foundation's scientific and development priorities are solving the clinical needs of the AO surgeons, the AO Research Board (AORB) is the overall advisory board responsible for AO research topics and structures, and the AO Research Fund (AORF) provides grants to researchers in the broad research areas of the AO Foundation.

The network to support these advisory boards was established almost 50 years ago. It has grown so that effective and much needed information exchange occurs between clinicians all over the world. For example, the requirements of clinicians to provide their patients with improved fracture repair have been fulfilled by the development of a wide range of mechanical devices. To supplement this, AO established a worldwide education system based on the experiences and expertise of AO surgeons. By assembling and teaching this knowledge, the AO Foundation achieved a worldwide reputation, especially in fracture healing.

To explore future opportunities in orthopedic technology and to address existing unsolved problems such as nonunions, new methods are needed. This is where the capability to harness and improve nature's own natural processes through the use of orthopedic biotechnology becomes important. Biological related technologies offer much promise for the future of fracture treatment, reconstruction, and the improved healing of musculoskeletal damage. Use of these technologies requires the development of a more diversified mission for the AO Foundation. To achieve this mission, the AO will need to understand:

- What will clinicians need in the next 10 to 15 years to improve patient care?
- How can biotechnology serve AO?
- What structures in the AO Foundation will be necessary to undertake the change from a biomechanical approach to the biotechnology approach?
- How the Biotechnology Advisory Board (BAB) can best advise and support the Foundation to develop in a timely manner the next generation of biologically based implants and therapies?

With this understanding, the AO Foundation will be able to play a leading collaborative role in the clinical application of biotechnology to patient care in the musculoskeletal field.

Group picture taken at the "1st BAB Strategic Planning Workshop on How to best use Biotechnology in the Orthopaedic Management of Bone Trauma" in May 2007 in Börsehus Malmö, Sweden.
From left to the right beginning from the front:
Wentworth B, Steiner S, Hofmann M, von Rechenberg B, Feinberg S, Pohlemann T, Renner N, Gruskin E, Alini M, Duda G, Urban J, Grainger D, Nunamaker D, Schneider E, Poole R, Haas N, Lerner U, Lidgren L, Guldberg R.

The potential and the challenges of orthopedic biotechnology

Biotechnology offers new opportunities for improving patient outcomes by improving current medical implants, and by offering completely new products and more effective therapeutic options. In the future clinical medicine will increasingly rely on contributions from biology. If AO is not continuously informed and capable of exploiting the latest biotechnological advancements it will risk losing its place as an international leader in therapeutic orthopedic surgical innovation.

This new undertaking in application is not simple: today's emerging basic and translational biotechnology knowledge is diverse, fragmented, and created in many laboratories worldwide. This rapidly moving field and the medical opportunities that it promises are enormous. Due to this complexity, the mix of biotechnology required to move toward a new technique or product cannot be carried out by any single institute. Neither is there a single company that may exploit or deliver such products. Because of this wide diversity, the AO Foundation must find the best partners to assist it in taking advantage of these new technologies in the defined areas that the foundation has committed to pursue.

An overview of publications in the search engine PubMed, using key words related to clinical requirements and biotechnology research reveals that the key words "fracture" and "infection" are cited about 1 million times, the key words "non-union" or "large bone defect" only several hundred times. For research topics like gene or cell therapies, stem cells, and antibiotics, the most-published work is on antibiotics followed by stem cells and gene delivery or therapy (for this short overview only a few of the most often used key words have been considered). Combinations of the key words “fracture AND antibiotics” reveal about 2,000 publications, while 30 citations were found for “antibiotic coatings AND implants”. If a combination of biotechnology terms and “fracture” are entered, the most hits are “BMP’s” followed by “stem cells”, “tissue engineering”, and “gene delivery/therapy” (all between 150 and 200 citations). This very superficial search was performed to demonstrate the current limited activity and maturity in using biological approaches in fracture management (taking the most prominent key words, a maximum of 0.1% of all fracture citations relate to biological approaches; based on the 74,000 citations for “stem cells,” only 0.2% are related to fractures). This means that these biotechnology research and technology areas are not currently primarily related to musculoskeletal diseases, but to all medical fields in general. More specifically, various strategies in biotechnology identify with potential clinical applications as a motivation, but to date are not developed sufficiently to commit to specific products with much confidence. Consequently, one task of the Biotechnology Advisory Board is to recommend the most important and appropriate opportunities in orthopedic biotechnology and to promote and integrate research and development in this area through networking outside and within the AO Foundation.

Today’s emerging basic and translational biotechnology knowledge is diverse, fragmented, and created in many laboratories worldwide.

The activities of BAB

Based on the desire of the AO Foundation to create an orthopedic biotechnology based research network, three years ago BAB started to bring together interested researchers and clinicians. An open call for research projects in this field from about 100 researchers and groups resulted in about 80 project proposals of which eight were funded in applied research projects in the fields of biomaterials, gene and cell therapy in the USA and Europe. Most of these projects are ongoing and demonstrate the challenge of developing biotechnology for clinical applications. Additionally, research results in such new technology fields are difficult to predict and success is difficult to measure over the short term of two to four years. Hence, product visions and risk management are very difficult. (See also D Grainger, AO Dialogue, May, 2007).

Additional steps have been taken to establish a network of researchers who can collaborate with clinicians. In 2006, BAB hosted the first biotechnology research conference in Lausanne, Switzerland. This was attended by an international group of AO funded researchers and other experts in this field (the next conference is planned for 2008). In 2007, BAB joined the Canadian Arthritis Network in becoming a member of an international network of excellence in biotechnology in arthritis, comprising associations and foundations including the AO Foundation in Canada, USA, UK, and Japan. By encouraging an exchange of researchers, clinicians and trainees working in biotechnology related research, new knowledge will be created and interdisciplinary groups can be established to conduct common research themes in orthopedic biotechnology.

In addition, BAB is involved in creating a European network of “Competence Research Centres” (CRCs), which will contribute specialized expertise to complement that conducted at the AO Research Center (ARI). This kind of CRC network may be of interest for global expansion in the future.

To maintain such network activities within AO priorities for clinical progress, and to expand the research expertise and capability of such networks, BAB will continue to fund fellowships to promote collaboration between scientists and clinicians. Workshops like the one held in Malmö in 2007 on “Biotechnology in the Orthopaedic Management of Bone Trauma” are being held frequently to address and discuss the application of biotechnology to meet specific clinical needs and priorities relevant to the AO specialty networks. These discuss problems in detail and are intended to educate and deliver more detailed information to clinicians.

Towards an orthopedic biotechnology vision

The AO orthopedic biotechnology vision must be based on the unmet needs of surgeons. This means that the AO Foundation has to develop a master plan for the clinical requirements and the research opportunities which can be implemented in an overall strategy of the foundation. A possible objective for 2030 could be "to better predict and manage the bone healing process", eg, to be more aware of (i) the patient's genetic status (profiling the good versus bad healer?) and the influences of comorbidity on the healing process, (ii) detailed knowledge about molecular and cellular processes in musculoskeletal sites, and early recognition of the distinction of healing from nonhealing physiology, (iii) effective alternative treatment options for device-centered and musculoskeletal infections, (iv) functions and risks of externally delivered systems (processed genes or cells, pharmaceutics/factors, materials, etc).

The development of such a long-term vision must start today as the biological revolution is continually producing a wave of new biotechnology advancements with the potential to impact upon orthopedics. In the case of nonunions, this could mean projects to determine information on normal and abnormal bone healing and the changes in nonhealing mechanisms, eg, in the presence of biomaterials. We need to understand the influence of the surrounding soft tissue compartment on healing and on neovascular development. We must understand how the use of super-physiological doses of growth factors/genes alters healing mechanisms. Such questions have to be answered in parallel to the development of new technologies, particularly those now investigated in the "Large bone defect healing" (LBDH) project, others solicited and evaluated by the BAB and the AORF, and those now being conducted under the guidance of ARI.

The BAB exists to support and to advise the AO Foundation in all aspects of orthopedic biotechnology.

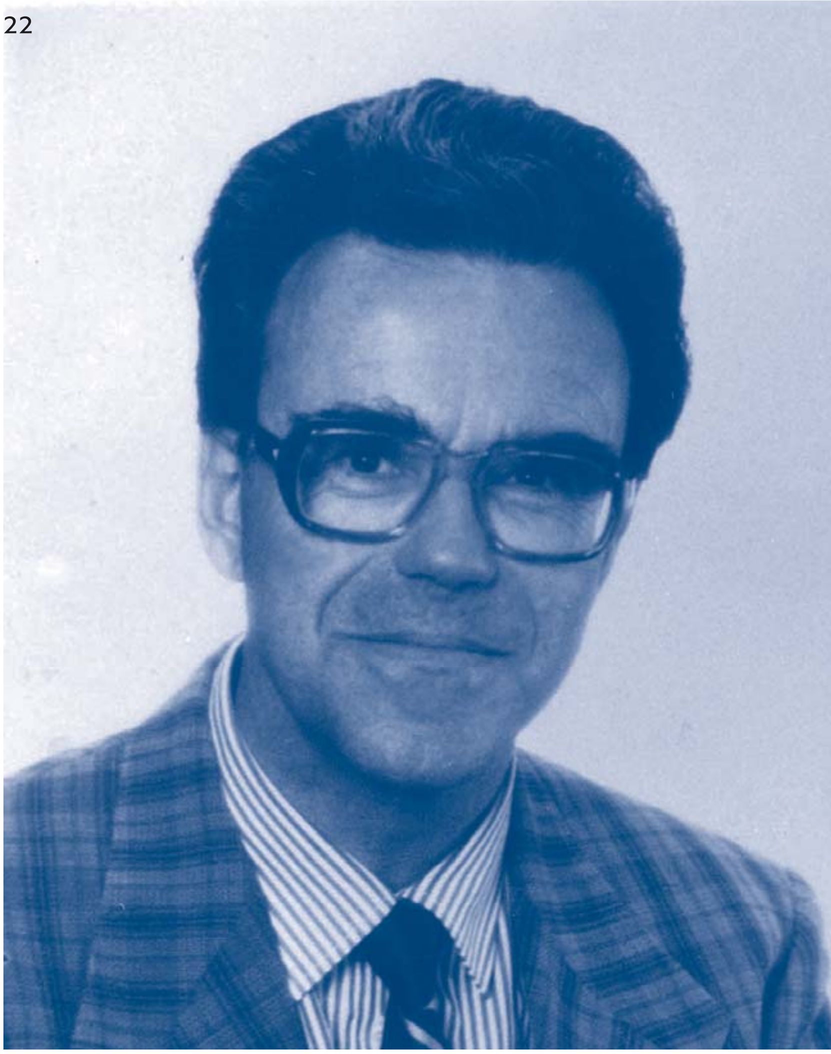
The BAB exists to support and to advise the AO Foundation in all aspects of orthopedic biotechnology. This advice comprises three pillars:

1. A long-term capacity to better predict and promote healing in different patients.
   • Continuous knowledge exchange with scientists and clinicians.
2. A medium-term capacity to identify and engage the finest expertise that exists in biotechnology and integrate it into the network of the AO Foundation.
   • Creation of an AO biotechnology research network partnering with existing networks like the Canadian Arthritis Network (CAN).
3. A short-term vision which is designed to promote collaborations with leading researchers, institutes, and companies to develop the next generation of biologically based orthopedic biotechnologies.
   • Partnering with companies in this field and the creation of a network of Collaborate Research Centers (CRCs).

The BAB cannot come up with one simple solution as most biotechnology approaches are complex by nature and need to be carefully and specifically developed as tailor-made for a given clinical application. However BAB can provide the expertise and create a network of competence, it can guide and provide direction and promote research in biotechnology and thereby engage biotechnology that will effectively serve the needs of the AO Foundation.

With its worldwide network of collaborating scientists and surgeons the AO Foundation is ideally positioned to develop and evaluate new biotechnology tools for its future needs. This offers extremely attractive and unrivalled opportunities for collaboration with industry and leadership within the clinical community.

Acknowledgement: The author would like to express her gratitude to BAB members, especially Robin Poole and David Grainger for offering suggestions for improvement.



Integral member of the pioneering generation

Professor Herbert André Fleisch
Head of the Laboratory for Experimental Surgery in Davos 1963–1967

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With the passing away of Herbert Fleisch in 2007, a great personality and an internationally renowned scientist has left us. The AO Foundation owes him a tremendous debt of gratitude for his excellent bone research and for his enthusiasm to make research by AO accepted worldwide.

Herbert Fleisch grew up in Lausanne, Switzerland. His father, a professor of physiology, conceived the worldwide renowned diagnostic tools in lung physiology (Fleisch spirometer). For our own early research in shock induced disseminated micro vascular thrombosis, he constructed the agglometer, a micro filtration method, which allowed the detection of micro emboli in the streaming blood; a method which could even today help to clarify clinically important issues related to intramedullary nailing.

Herbert studied medicine and started his research in 1959 in the USA laboratory of Prof Newman who introduced him to the biochemistry of the pyrophosphates, the precursors of the later Diphosphonates and today's Bis-phosphonates.

From the outset, the AO, founded by the visionary Maurice Müller and his colleagues, was aware of the fundamental importance of a strong scientific background through research enabling true leadership. Quality monitoring of clinical activity was also required to evaluate progress. This input allowed the technology of implant development and teaching of the methods to be creative and solid. To ensure that AO could provide the necessary research activities for its success, Martin Allgöwer established the Laboratory for Experimental Surgery in a temporarily abandoned tuberculosis research institute in Davos.

> **His lectures on frontiers in research provided the scientific credibility that the AO required.**

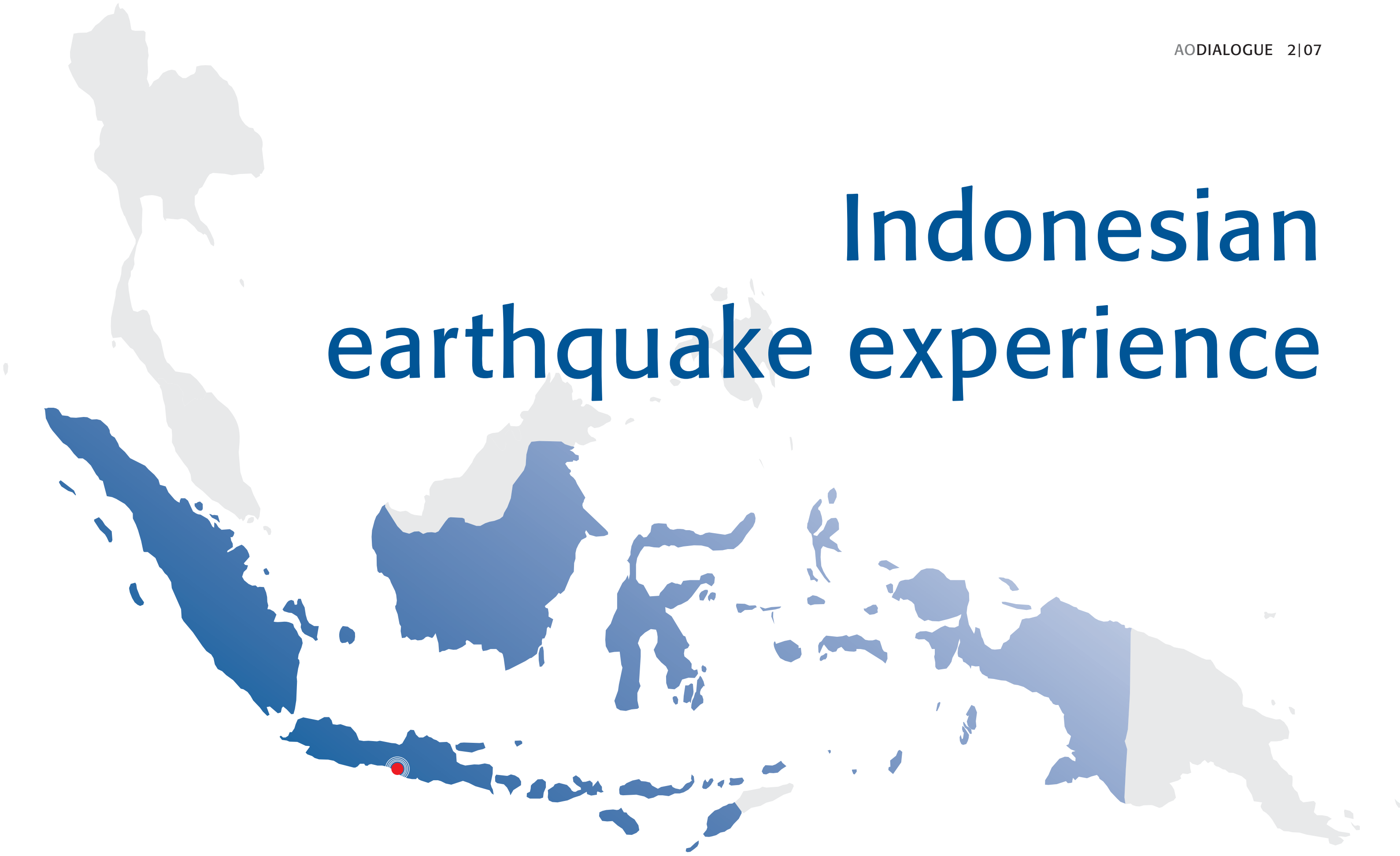
> **Herbert was an outstanding pioneer in a difficult setting.**

For the first few years the Laboratory actively investigated hemorrhagic shock, burns, and wound healing. When Herbert became director of the Lab in 1963, this heterogeneous work group fell under his administrative responsibility. With his biochemist, Dr Bisaz, he took up experimental research in bone biochemistry. His main interest was bone formation and destruction with special interest in the effects of the Phosphonates. In the early critical years of the AO, he supported our biomechanics group which analyzed pressure necrosis and helped to prove to the world that compression in internal fixation had no deleterious effect on living bone. Also under his guidance in the laboratory in Davos was the AO documentation center, the brainchild of Maurice Müller. In 1967 the structure of the AO institute was reshuffled. Herbert left with his biochemistry group to head the newly founded Institute for Patho-Physiology at the University of Bern. Maurice Müller moved the AO documentation to Bern while Martin Allgöwer took over the Department of Surgery at the University of Basel transferring shock, burn, and wound healing research to Basel. The group remaining in Davos was a small one of five people focusing on mechanical research supporting the AO.

Herbert was a great teacher. Along with Robert Schenk, he made bone a living reality with their superb lectures on "Structure and Physiology of Bone". His lectures on frontiers in research distinguished the AO courses from pure technology workshops and provided the scientific credibility that the AO required for its new operative fracture care methods.

The early days of AO research were demanding in a setting of daily threatening financial insecurity. We owe much to people like Herbert Fleisch and the early trustees of the Foundation of the Research Institute in Davos who prevented it from running dry with financial support out of their own pockets. We must not forget that the root of the brilliant success of the AO Foundation and its business partners was the risky personal engagement of enthusiastic people like Herbert, an outstanding pioneer in a difficult setting.

Indonesian earthquake experience



Indonesia has a population of over 200 million, and less than 200 orthopedic surgeons. On May 27, 2006, an earthquake measuring 6.3 on the Richter scale struck the Indonesian main island of Java, 25 km south of the densely populated city of Yogyakarta. Over 5,000 people died, 36,000 were injured, and approximately 1.5 million were left homeless.

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The disaster prompted responses from many government (military and civilian) and nongovernment organizations worldwide. The Australian government deployed a 27 member civilian emergency response team consisting of medical and nursing personnel, and logistics support. The surgical component of that team consisted of two orthopedic surgeons, two general surgeons, two anesthetists, and four operating room personnel, along with enough equipment to run a self-sustained operating room. I was the senior orthopedic surgeon on this team, and this was my first experience in such a situation.

While many relief workers went to the outlying regions that were most affected, we set up our operations in Yogyakarta, as most patients with orthopedic injuries had been evacuated to that city due to the lack of essential services in the affected areas. Fortunately for me, this meant sleeping in a hotel and operating in a hospital, instead of doing both in a tent.

Approximately 2,000 patients were treated at the main teaching hospital, Sardjito, where local doctors were supplemented by some of the earliest international arrivals, such as the Rus-

Fig 1 Approximately 1.5 million people were left homeless.
Fig 2 The postanesthetic unit at the basketball stadium.
Fig 3 Modified traction.

sians and the Finns. Many more patients had been admitted to the numerous other hospitals throughout the city. Most of these were small hospitals with only a few operating rooms, and some were field hospitals, usually set up by the military (local and international). We worked in two small metropolitan hospitals, and one field hospital, which had been set up in an unfinished sports stadium. I worked mainly in one hospital, running one operating room, alongside other ORs run by local and international surgeons.

It took two weeks to clear the backlog of patients with fractures.

The extent of the international response was noticeable everywhere in the city, where groups of relief workers from countries as diverse as Turkey, Japan, Norway, and the US could be seen. Although the first 48 hours (before our arrival) were quite hectic, the next two weeks (which is about how long it took to clear the backlog of patients with fractures) went by in a very unhurried and efficient manner, with most teams heading out in the morning, and returning for dinner, debriefing, and a good night's rest.

I had the opportunity to visit the main hospital (Sardjito) and was impressed by their response to the disaster. They admitted that what helped was having performed recent disaster exercises in preparation for a predicted eruption from nearby Mount Merapi volcano (25 km to the north). Within a few hours of the earthquake, they had cleared 2/3 of their patients from the hospital to make room for the incoming patients, and while the building was being inspected for damage, they wasted no time by triaging the newly arriving patients.

It was interesting to see the pattern of injuries sustained, as this varies significantly in natural disasters, depending on the cause. Earthquakes, I quickly learned, cause orthopedic injuries. Apart from a few head injuries that were treated in the first few days (before our arrival), and a handful of open fractures, there were literally

Extending the indications for fixation with a straight LCP.

thousands of closed fractures requiring orthopedic treatment. Virtually all of the operating performed over the next two weeks consisted of fracture fixation. The operative workload was so one-sided, that one of our general surgeons went home after a few days, and the other spent his time airlifting patients from, and supplies to, the worst affected areas in a helicopter.

The work was surprisingly well-organized, as each hospital had at least one aid group from one country or another. So although thousands of fractures were treated in the three weeks following the earthquake, each hospital only treated a few hundred, making it much more manageable.

Although there were sufficient operating rooms, anesthetic supplies, and personnel, there was a distinct deficiency in orthopedic implants. Soon after arrival, I arranged for a large donation of internal fixation equipment from Synthes Australia to be shipped over, as we only had external fixation equipment, and once we had treated some open tibia fractures, it was no longer required. I had a difficult task in deciding what implants to ask for. We only had small portable sterilizers, and none of our hospitals had intraoperative radiology facilities. I therefore opted for locking plates (large and small straight LCPs) and no nails. I soon discovered that almost any fracture can be treated with a locking plate. I also had Synthes send over several boxes of disposable hip drapes, as these could be used for any extremity fracture.

Operating was difficult, not only because of limitations imposed by sterilizing, the lack of imaging, and the limited equipment (for example, I would need to pull out every screw and plate I thought I would need prior to each case, as the sets did not fit in the sterilizer), but because of so many nonoperative factors, such as the language difficulty, and the lack of air conditioning (remember that Indonesia lies right on the equator). Considering these hardships, I was very happy with the way the operations went, and many of the fractures were able to be fixed percutaneously. I was particularly surprised at how much I could do without any intraoperative imaging.

Although our team only played a small part in the overall relief effort, it was remarkably satisfying, not only to treat the patients, but also to see a large number of aid workers from so many countries come together, and, from a personal perspective, to operate successfully under such trying circumstances.

AO Tips for Trainers Course in Budapest, Hungary

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Background

In May 2005, at an AO regional course in Slovenia, several enthusiastic AO alumni leaders from different countries (Slovenia, Hungary, Israel, Bulgaria, Turkey, Poland, and Russia) expressed a desire to create a new AO region, as envisioned by Dr Ales Andrej, a Slovenian AO Trustee member. It was later renamed AO MID (mid-Europe). Since AO MID's conception, we have held four AO regional courses, the most recent one being in Antalya, Turkey, from June 18–22, 2007.

The AO Tips for Trainers Course

A T4T course took place in Budapest, Hungary from January 17–18, 2007, with the goal of hosting an event for the international regional faculty of AO MID. A multicultural mix of keen trauma surgeons from Slovenia, Hungary, Israel, Bulgaria, Turkey, Poland, and Russia met in the beautiful Hungarian capital of Budapest to develop their educational skills and knowledge.

This international faculty included Lisa Hadfield-Law from the UK. Her excellent presentation method was exciting and unforgettable. She was assisted by Bonczar Mariusz and Jarek Brudnicki from Poland, and Rami Mosheiff and Steve Velkes from Israel.

By the end of the sessions all the students had developed the characteristic skills necessary for an AO faculty member and learned to articulate their own development needs, describe the seven principles of learning, and identify the principles of discussion. During the practical sessions, students gave a five minute microteaching presentation and received feedback from both the international faculty and the other students. Teaching practical skills was approached in a four stage teaching method using nonclinical skills and constructive feedback.

It was my privilege to be an active T4T course participant for the second time (first time being in Pfäffikon, Switzerland). Based on previous experience, in my opinion this was a marvelous learning experience and deeply ingrained the basic principles essential for future teaching with the AO family. Based on the students' feedback we were successfully trained by the appointed teaching faculty and are ready to represent the potential faculty for the AO MID region.

The growth and development of AO in Singapore

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In the early 1970's, Singapore began embracing the AO philosophy in its management of musculoskeletal injuries. Through the efforts of eminent orthopedic surgeons, our relationship has continued to grow over the years. Today, due to the emphasis AO places on the quality of teaching and training methods, AO is accepted as an integral part of orthopedic practice in Singapore with the AO Principles Course included in the training curriculum for orthopedic surgeons.

ORP activities in Singapore

Surgeons realized early on that one of the most efficient and cost effective ways of training was to conduct our own AO Courses. Beginning in 1984, we have regularly run AO courses and seminars. With the widespread adoption of AO techniques, the demand and necessity for skilled and trained OR personnel grew proportionately.

In the early years, orthopedic nurses were unaware of the reason for the choice of instrument and implant. Any desire to improve knowledge on the subject was obtained by asking other nurses or the orthopedic surgeon. Twenty-two years ago, the combined AO Principles and ORP Courses was introduced to Singapore by a group of orthopedic surgeons who considered the education of operating room personnel to be as important as that of surgeons. The course was

Faculty bringing the AO Principles to Singapore

conducted in conjunction with the surgeons and consisted of lectures and a demonstration of Synthes instruments.

In 1990, the OR personnel course was totally reorganized so that both the Principles Courses for OR personnel and surgeons ran simultaneously at the COMB's building, Outram campus of Singapore General Hospital. This enabled the course organizers to utilize the surgeons as lecturers for both courses. Lectures on AO principles, philosophy, fracture patterns and management, and group discussions were introduced as part of the course. Highlights of the course were the video sessions, and hands-on practical exercises using the actual implants on simulated fractures in synthetic bone.

Subsequent AO Principles Courses and AO ORP Courses were run simultaneously in 1990, 1994 and 1998. The courses planned for 2002 and 2003 did not happen due to unfortunate events in a neighboring country, and SARS, a global pandemic.

Current situation

Today, the ORP course program is prepared by the ORP faculty. The course has been consistent in meeting AO standards of lectures, workshops, learning material, video sessions, and modern adult teaching techniques. This was largely made possible by the late Anne Murphy who supported and closely monitored this endeavor. Since her passing, all educational activities have been carried out with the support of Susanne Bäuerle, the present director of ORP Education, and her assistant, Isabel Van Rie.

Running the course

The greatest benefit arising from running the courses simultaneously is the ability to combine the ORP and the surgeons' courses emphasizing the importance of a team approach in trauma management.

Based on international AO formats for the Principles Courses, the general principles as well as lectures covering anatomical specific injuries including the hip, femur, tibia, and ankle are now taught. The topics contain one session by a surgeon concerning the specific fractures and injuries of that region followed by a session given by an ORP concerning the operating room setup, positioning and care of the patient on the traction table, use of a tourniquet, air and powered instruments, care and maintenance of AO instruments, and asepsis in the OR. Other topics included are radiation safety in the OR, given by an expert radiographer, and a lecture on legal issues in the OR setting given by a pioneer AO surgeon, who is also a qualified lawyer.

Other topics presented in the three day ORP course include the history and philosophy of fracture treatment, primary and secondary fracture treatment, screw and plate fixation with conventional and locking plates and screws, tension band wiring, intramedullary nailing, the importance of soft tissue management, concerns for mal and nonunion, infections, and handling of multi-trauma patients.

During the course each practical table consists of one ORP and one surgeon serving as table instructors, with a director in each of the practical rooms who oversees the running of the practicals moving between all the groups. The ORP

and table instructors remain with the same participant group during the entire course. They facilitate all the group discussions and supervise the group during practical exercises.

During the discussion sessions, instruments and implants are discussed to ensure that participants understand how they are used. As the participants' orthopedic and practical experience varies widely these discussions serve to prepare the participants for and facilitate the practical sessions. The main purpose of discussion sessions is to promote interaction between teacher and student. The content of each group discussion session is, as far as possible, connected to the previous lecture and to the following practical.

Organizing AO Courses is not only an enriching experience, it also creates an opportunity for our nurses to become teachers and instructors, to stand on an international platform. Course chairs have, in the past, been one surgeon and one ORP. This year, I have the privilege of being involved as a local chairperson, together with the support and guidance from the AO Education chairperson, Ms Isabel Van Rie and local AO courses director, Mr Wong Merng Koon.

Learning opportunity for ORP

After running successful local AO ORP Principles and Advances Courses a few ORP instructors and teachers have been invited to teach in neighboring countries such as Malaysia and Sarawak. Those who showed promise were encouraged to apply for AO Fellowships to further their learning experience. The few who decided to dedicate their time to AO teaching were invited to attend the AO Educators Seminar for ORP at Davos, Kuala Lumpur, Malaysia (2000), or Chang Mai, Thailand (2006). In 2005, the ORP were invited to attend the surgeons' Triennial AOAA Symposium, September 18–21, in Sardinia, Italy. Asian ORP Alumni representatives also attended the meeting and discussed the possibilities of an AO manual for ORP with AO Publishing.

AO Center

An important milestone in the development of AO in Singapore was the setting up of an AO Center in 1990, located in the department of Orthopedic Surgery of the Singapore General Hospital. This center is run by a committee which oversees documentation, training of local surgeons and nurses, as well as training of AO Fellows from neighboring countries. It is now in charge of all AO educational activities in Singapore including the organization of AO courses. As a result, the care of musculoskeletal injuries has attained a high standard. Our surgeons and nurses are well-trained and keep abreast of the latest developments in AO.

The future plan of AO activities in Singapore is to take an active part in a regional framework with our counterparts in AO Asia Pacific. There is great promise and scope for cooperation for us to learn and improve our knowledge, skills, and results through regional networking under the auspices of AO Education.

The Singapore AO faculty members work as a team, devoting their time and efforts to evaluate and improve the educational programs and activities. We believe that our efforts result in improved patient outcome, which at the end of the day is what we are all striving for.

Synman—the newborn baby of Synbone

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"Who is Synbone, the mother?" Synbone provides you with plastic bones during your practical exercises at AO courses anywhere in the world. Beginning in 1983, in Filisur, Switzerland, Synbone began to manufacture plastic bones. By 1998, the demand had increased so that a larger and more modern facility was developed in Malans, Switzerland.

The Advanced Trauma Life Support (ATLS)® course—the father—began in 1964 and offers courses worldwide in the initial acute management of the injured person.

For realistic ATLS surgical skills teaching, pigs and sheep were used, most of the time living or cadaveric samples. These models are costly and inappropriate in many areas of the world. For these reasons other possibilities for surgical skills teaching were sought.

In 2004, Synbone tried using plastic models and by the beginning of 2006 had developed manikins, which were useful for these exercises. In April 2006, Synbone presented the manikin at the European ATLS Meeting in Torino, Italy, and it received a positive response with many suggestions for improving the model. At the annual meeting of American College of Surgeons, Committee on Trauma in October 2006, the manikin was presented by ATLS Switzerland in Chicago. This model was well accepted, suggestions were made again, and the proposition was expressed to the European Faculty to evaluate this model and to present the results at the Spring Meeting of the Committee on Trauma in Denver.

At this time the "Synman" was born. The results and the manikin were presented in Denver on March 15, 2007, to the Committee on Trauma of the American College of Surgeons and to the ATLS International Board. These governing bodies approved the Synman for ATLS Courses.

Synbone and the AO Foundation (which owns 90% of Synbone) are both are very proud to have this little baby on board. AO's concerns for the injured patient go hand in hand with the ATLS philosophy, to give the injured patient the best chance to be treated by a well trained team, in the appropriate way, following generally accepted rules.

Carefully planned and well conducted prospective clinical studies provide the best evidence about efficacy and safety of orthopedic surgical treatments. Case series, registries, and retrospective data are less valid sources of evidence.

Beate Hanson

The new role of AOCID as a partner in clinical research

The AO Foundation has placed prospective clinical research at the top of its strategic priorities. This new strategic orientation requires development of many important methodological, logistical and regulatory skills. Good study design, sufficient sample sizes, high follow-up rates, multicenter and multinational participating sites, advanced statistical methods combined with the highest standards in protecting safety and privacy of the patients who volunteer to participate in the studies are but a few key elements to success.

New requirements

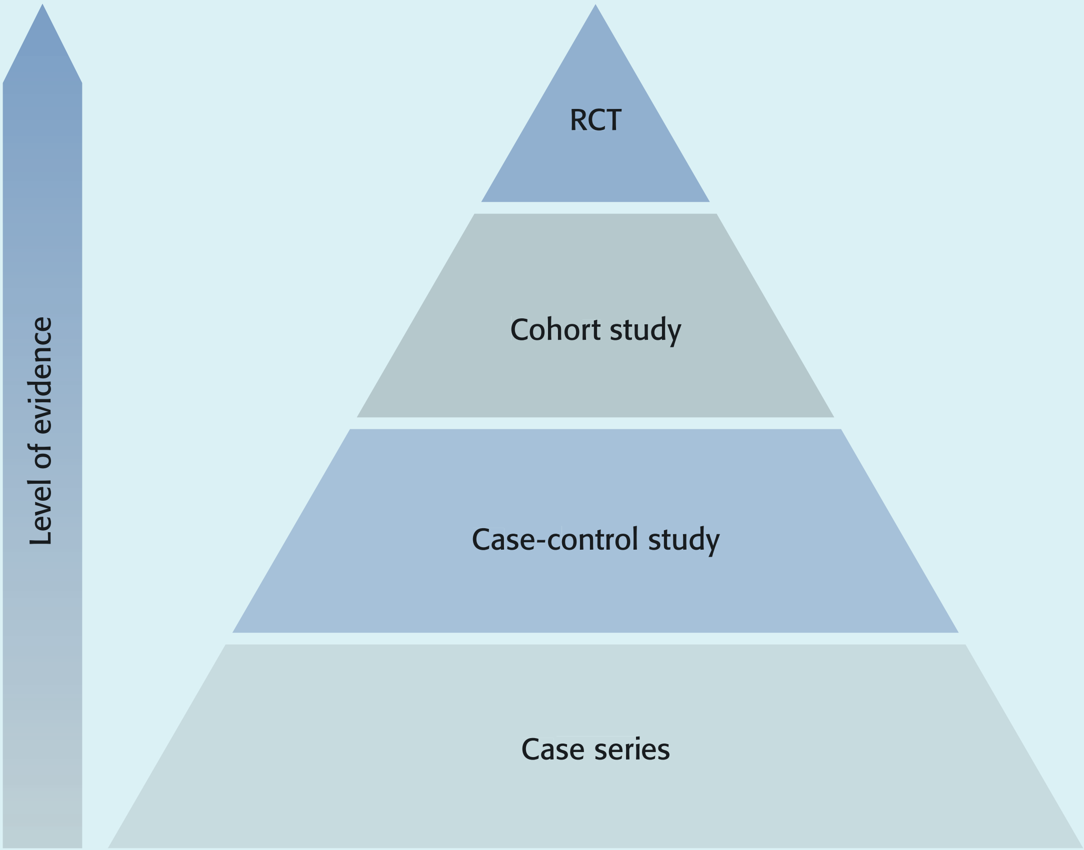
The AO Registry of clinical cases based on the Müller AO Classification of fractures was the mainstream clinical research approach in the nineties. With the emergence of evidence-based orthopedic surgery in the late nineties, the focus of clinicians, patients and policy makers has shifted towards patient relevant outcomes such as function, pain, and quality of life. Parallel to that, in the light of ever increasing health care costs, demand for evidence about cost-effectiveness of new and competing therapies, devices and diagnostic equipment has emerged. Registry-based information became insufficient to provide the level of evidence required to provide answers to these important clinical and policy issues. Registration was discontinued and the focus was then transferred to prospective clinical research. The goal is to provide high quality data from clinical studies that will lead to scientific publications in clinical journals and contribute to advance science and the practice of orthopedic surgery.

New organization and skills

The new focus required new skills and approaches. To meet these new challenges, AO Clinical Investigation and Documentation (AOCID) has undergone a significant internal reorganization.

The work focus has shifted toward skills and knowledge of importance to design, conduct and report good quality clinical trials. Our services focus on close collaboration with AO surgeons. Ideas are brainstormed and sharpened by combining clinical experience and expertise, public health relevance and literature overviews. Study methodologies are at the apex of new developments in study epidemiologic and statistical design. Studies are conducted in international environments with challenging regulatory and language requirements.

AOCID is currently focusing on high quality prospective multicenter clinical studies, randomized controlled trials and observational studies. Significant internal growth has occurred. Expertise has been strengthened in all relevant professional areas: systematic review of literature, study planning, advanced statistical planning, regulatory preparations, monitoring, data management, along with technical and scientific reporting.



Good level of evidence arises from well designed and conducted observational studies (eg, cohort and case-control studies). The gold standard remains a randomized controlled trial (RCT).

In addition to the core business of clinical studies, AOCID has engaged in development of advanced computer-assisted fracture classifications and, most recently, new computer-aided patient outcome instruments.

A range of services is offered to assist clinicians, researchers and device manufactures with study design, study methodology, statistical planning and analysis, literature overviews and assistance with scientific reporting.

Current AOCID

Currently, AOCID has 25 permanent staff and a number of external subcontractors and investigators are engaged in clinical studies conducted across 150 different clinical sites on four continents. Studies are performed for various elements of the AO Foundation and involve all three specialties (trauma, craniomaxillofacial and spine). In addition, industry sponsors are using AOCID services to conduct scientific and regulatory studies.

The future of AOCID is to evolve into a leading global clinical research organization for orthopedic surgical trials thus helping clinicians, organizations and, ultimately, patients to achieve better clinical results by use of evidence-based clinical approaches.

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Portrait of Beate P Hanson, MD, MPH

David L Helfet

Beate Hanson

The AO is most fortunate that Beate Hanson decided during her residency in general and orthopedic surgery from 1994–1998 that she was most interested in epidemiology, clinical investigation, and public health and not in the clinical practice of medicine. Accordingly, she completed a Masters in Public Health at the University of Washington and joined AO Clinical Investigation and Documentation (AOCID) as a research scientist at the same time. In 2002, upon the resignation of Ruedi Moser, Beate Hanson took over as Director of Clinical Investigation and Documentation at the AO.

Ruedi Moser had previously been able to restructure AOCID and move the organization from a documentation center to more of a clinical investigation center. Beate Hanson, with her clinical and epidemiological background, solidified this change and has been able to take AOCID to new heights. AOCID, now under her leadership, is an ISO Certified Department of Clinical Investigation, nationally and internationally recognized and even sought after by outside vendors for their expertise. The numbers are quite staggering. She manages a division with a staff of 25, currently coordinating 22 ongoing studies, involving 150 hospitals, 20 countries, and 2,353 patients. An additional eleven studies are in the planning phase. In addition, AOCID handles 175 external requests and on average generates 25 publications per year—quite an accomplishment.

But those are just statistics. More important, the AO is family and Beate Hanson understands that better than most. She is very loyal and supportive to her team in CID and well respected as a result. She knows how to "deal" with the physician/surgeon members of the AO, ie, to understand the clinicians and their concerns, to be supportive of their knowledge quest, to educate them as to the techniques and methods of practical clinical investigation and to nurture them through the process from question to publication. She accomplishes this all in a most endearing and collegial fashion. This does not just apply to Northern Europe or the US, she has become well-known throughout the AO world. She has spoken to AO Alumni Associations, national scientific meetings, and international meetings and at all of them she is able to make the search for real knowledge an enjoyable process and understandable to all.

All who come into contact with Beate are impressed. She is smart, a real expert in her field, knowledgeable, understanding of all the issues, problems and complexities in doing clinical research, and practical in her approach. More importantly, she has a warm and engaging personality, is a loving mother, fun to be with, and it is a pleasure for all who collaborate with her. We are really fortunate to have Beate Hanson as not only a member of the AO family, but one of its leaders.

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From a low-key start in 2003, AOCID North America has grown dramatically in size and capability.

Enno Boesche

AOCID in North America

AOCID opened a small office at the Hospital of Special Surgery in New York in 2003. Judy He was the sole employee then and her job was to monitor ongoing projects at US sites and to plan and carry out AOCID's first all-American clinical trial—the trochanteric femoral nail (TFN) study. This study revealed a great demand for clinical study services. By 2005, AOCID North America was able to initiate three new prospective and two new retrospective studies. Because technical aspects and regulatory affairs differ dramatically between Europe and North America, AOCID NA is utilizing new methods of internet-based onsite data capture, reducing data entry workload but making more monitoring demands. It became necessary to hire additional personnel and a larger office was opened in Princeton, NJ in 2006, the same year that Enno Boesche arrived from Zurich to act as business manager and liaise with the AO in Switzerland.

The TFN study was successfully completed and a publication has been submitted to INJURY (2007 Jun 18; [Epub ahead of print] Radiographic outcomes of intertrochanteric hip fractures treated with the trochanteric fixation nail. Gardner MJ, Briggs SM, Kopjar B, Helfet DL, Lorich DG) Data capture for the two retrospective studies ended in June and the data are currently being evaluated:

- In the study "An Assessment of Surgical Techniques for Treating Cervical Spondylotic Myelopathy—Retrospective Study" (CSM-r), data on 300 patients have been extracted.
- In the study "Comparing surgical to conservative management in the treatment of Type II odontoid fractures among the elderly—Retrospective Study" (GOF-r), data on 75 patients have been extracted.

The three prospective studies in progress are proceeding well, recruitment for two of these studies was completed in June 2006:

- In the study "An Assessment of Surgical Techniques for Treating Cervical Spondylotic Myelopathy" (CSM) over 250 patients were recruited.
- In the study "Comparing surgical to conservative management in the treatment of Type II odontoid fractures among the elderly" (GOF) nearly 80 patients were recruited.

Both studies are showing follow-up rates of around 80%, a high level CID NA is confident will continue.

CID NA requires highly qualified and motivated coordinators in their collaborator clinics. To strengthen these relationships and to answer any open questions, CID NA organized a study coordinators' meeting in April, 2007. CID NA coordinators and nearly 20 study centers attended this meeting for two days of presentations, discussions and personal interaction. Thanks to this collaboration, CID NA will be able to expand its reference clinic system in North America. This reference center system (based on the successful European experience) consists of a group of study centers chosen through systematic evaluation of their quality, quantity, and ability to perform exceptional clinical research.

Given the current status of the ongoing studies and five new studies in the planning phase, AOCID's expansion is proving to be a great success and contributes to the AO's excellent global system of services, advice, and collaboration.

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This article outlines the processes and results of using several international trauma units to study the Philos plates.

Felix Brunner and Reto Babst

The multicenter Philos study: collaboration between CID and participating clinicians

Planning

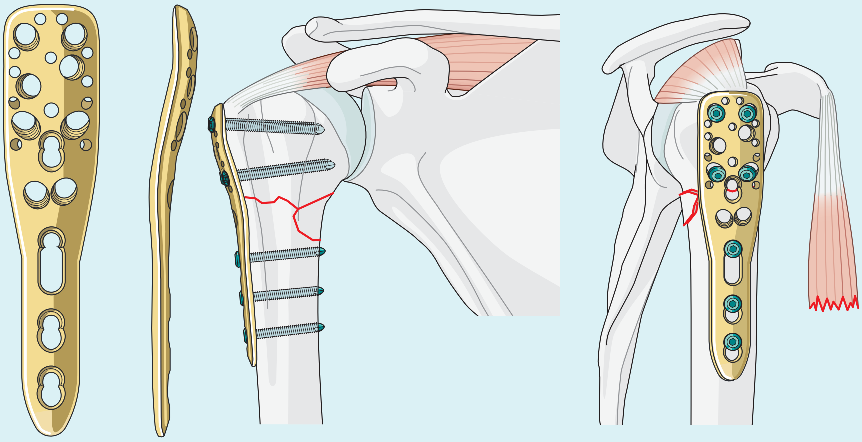
The incidence of proximal humeral fractures has greatly increased over the last several years, most likely due to an increasing elderly population with osteoporosis. An end to this exponential increase in the frequency of these fractures is unforeseeable. As a result, the surgical treatment of displaced fractures, especially in the elderly, is becoming more important than ever. With the development of angular stable plate fixation a new tool for the treatment of proximal humeral fractures—the Philos plate providing enhanced purchase in osteoporortic cancellous bone—has been created. Therefore, a decrease in the occurrence of previously known complications such as secondary loss of reduction, pseudarthrosis, screw and plate loosening, and avascular head necrosis is anticipated. A prospective case series planned by CID in conjunction with a number of trauma shoulder surgeons was undertaken to evaluate complications and functional outcome after ORIF with the Philos plate. The developed study protocol involved perioperative assessment to obtain clinical and radiological information at baseline, as well as at three, six, and twelve month follow-up visits. As functional outcome measurements, the Constant, Neer, and DASH scores were chosen. In each participating clinic, the local ethics committee granted approval to conduct the study.

Monitoring

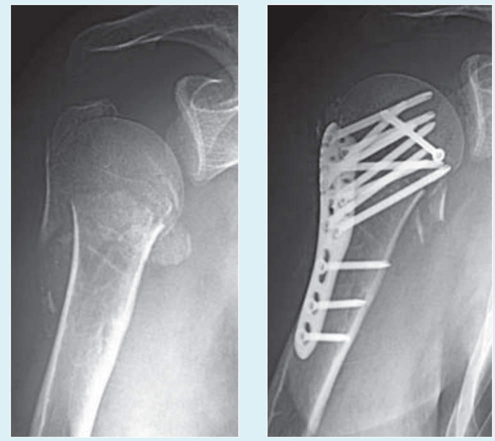
From September 2002 until March 2005, 157 patients with 158 proximal humeral fractures were recruited at eight trauma units in Germany (Kaiserslautern, Rosenheim, Tübingen), Sweden (Stockholm) and Switzerland (Chur, Davos, Fribourg, Lucerne). Each clinic assessed their patients at baseline and follow-up visits using the respective standardized questionnaire complete with x-rays (AP and Neer‘s view). Data were collected at the CID office in Davos and entered into a database, checked for integrity and prepared for further analysis. Due to conscientious monitoring, follow-up rates of 88%, 82%, and 84% were attained at the three, six, and twelve month follow-up examinations, respectively.

Statistical analysis and publication process during a fellowship at CID

To achieve an ideal exchange between statisticians and clinicians, Felix Brunner had the opportunity to play a chief role in the data analysis during a fellowship at CID; this exchange turned out to be inspiring for all parties involved. During this fellowship, the members of the CID staff taught him the necessary epidemiological and statistical concepts, and as a surgeon from a participating center, he could contribute his clinical knowledge to the analytical process. This interaction of a clinician with scientists facilitated the communication between CID and the principal investigator of the study. As well as the usual statistics regarding demographic and functional outcome parameters, they particularly focused on the analysis of reported complications. Together with the principal investigator, all information and x-rays from patients with reported complications were reviewed. Any complication was



Locking plate (Philos) fixation AP and lateral view.



Subcapital fracture right humerus reduction and internal fixation with philos plate.
Preoperative and postoperative lateral view.

defined if its occurrence was implant or nonimplant related (eg, surgical technique, general surgical complication, result of the trauma), and complication risks were also calculated. By the end of the study, Felix Brunner was able to successfully conduct all the statistical analyses, as well as compose a manuscript for publication.

Results and comments

Reflecting on the typical study population with proximal humeral fractures, the mean patient age was 65 years and three-quarters were female. In addition, 75% of the patients sustained a low energy trauma, mostly due to a simple fall. According to the Müller AO Classification, 25%, 39%, and 37% of the fractures were observed as Type A (2 part), B (3 part), and C (4 part or valgus impacted) fractures, respectively. In total, 71 complications in 53 patients led to 39 unplanned reoperations within one year. Main problems involved primary screw perforations of the articular surface due to erroneous placement of 'too long' screws (n = 22), followed by soft tissue complications (eg, frozen shoulder, impingement) (n = 15), secondary screw perforation due to impaction of the humeral head (n = 13), and avascular head necrosis (n = 13). Patients were at a 9% risk of sustaining an implant-related complication. This risk increased to 36% for a nonimplant-related complication. In patients over 60 years of age, the complication risk was almost doubled (relative risk 1.9, $p = 0.02$), whereas patients with Type B and C fractures were at a 1.8 times higher risk of experiencing any complication compared to patients with Type A fractures ($p = 0.05$). After one year, the functional outcome using the Constant score achieved a mean of 72 points (SD 15.2), and on average 87% (SD 16.6%) of the score of the contralateral, healthy shoulder.

Our results are comparable with published and congress communicated results of other case series evaluating the Philos plate. Excellent primary stability can be achieved and previously feared complications (ie, loss of reduction, implant loosening, AVN) have either become a rarity or did not appear in our study (pseudarthrosis). Although complications due to surgical technique (particularly those of primary screw perforations) occurred and overshadowed the good anatomical and functional outcome obtained in all performed trials, future reflection regarding screw length measuring techniques must become a priority for surgeons and developers.

Overall, we strongly believe that multicenter studies like ours—performed in various clinics of different care level—better reflect the clinical reality compared to single center evaluations of an implant. Therefore, we encourage CID and clinicians to continue designing multicenter studies, even though they are more demanding in consideration of the design, monitoring, and analysis procedures. But with the help of CID staff, these challenges are both fun and accomplishable.

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This article details a study into the effectiveness of using locking compression plates of various sizes to treat distal radial fractures.

John-Sebastiaan Souer and Jesse B Jupiter

Prospective clinical study: locking compression plate for distal radial fractures

Introduction

At the turn of the millennium, interest in one of the most common of all injuries to the musculoskeletal system—the distal radius fracture—has surprisingly been renewed. We are now confronted with a marked pendulum swing towards stable internal fixation with plates and angular stable screw fixation. Therefore, it is surprising that in the contemporary literature there is little evidence to support this surgical approach with such fractures.

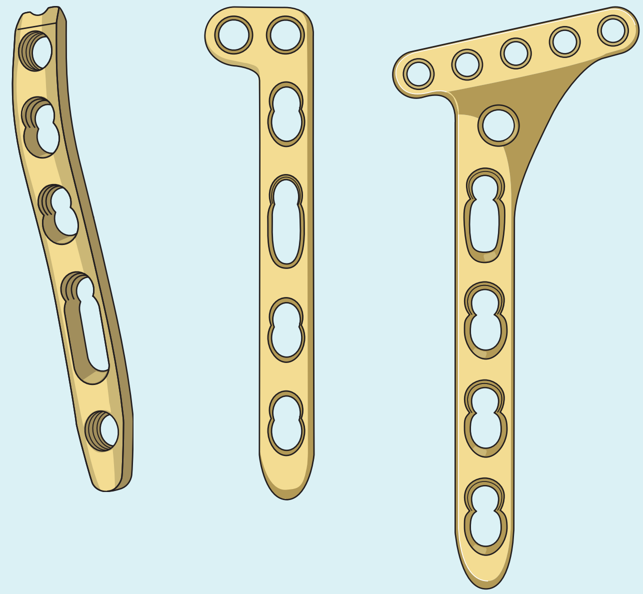
In 2001, a prospective cohort study was initiated under the auspices of AOCID to evaluate the effectiveness of using the locking compression plates (LCPs) 3.5 and the LCPs 2.4, in addition to a conservative arm. Both operative arms were conducted as independent case series in two groups of clinics. The LCP 2.4 plate study was under the supervision of Dr Jesse Jupiter at the Massachusetts General Hospital in Boston (USA) as principal investigator, and Dr Stefan Matschke from the BG Unfallklinik in Ludwigshafen (Germany) was the principal investigator for the LCP 3.5 plate study.

Nine centers contributed to the LCP 2.4 plate study. Over a two year period, 150 patients were recruited with a follow-up rate of 78% (n = 117) at the final two year examination. Inclusion criteria involved unstable fractures in adults over the age of 21 years. Along with thorough demographic data and radiological classification of the fractures, all patients completed a baseline DASH, as well as the SF-36 health status profile upon entry into the study.

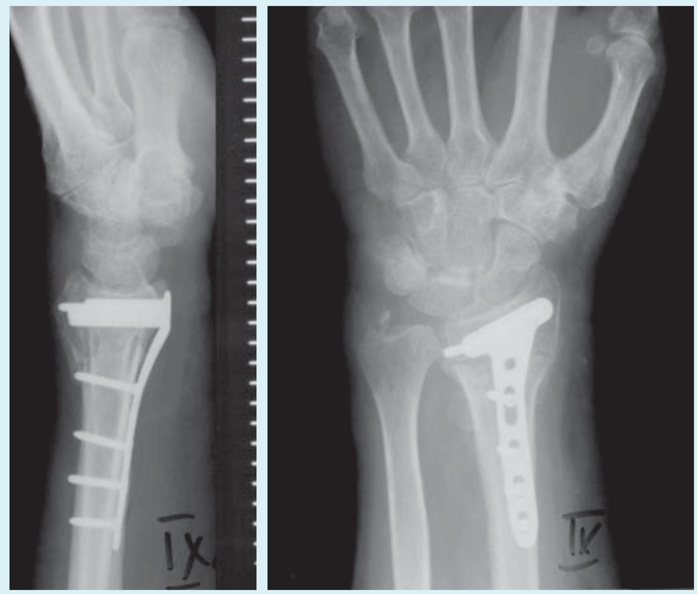
The surgical approach was left to the discretion of the treating surgeon with a palmar approach undertaken in 78% of the cases. The patients were followed after six weeks and six, twelve, and 24 months with motion, grip strength, pain, and radiographic analysis carried out at each visit. Patient-rated outcomes were also completed at the one and two year follow-ups.

The mean age of the patients was 51 years with 59% of the population being women, who were significantly older than the cohort of male patients. Eighteen percent of the fractures were AO Comprehensive Classification Type A and 71% were categorized as Type C, with the distal ulna involved in 48%. Only three fractures were open.

Overall, consistently significant improvements were observed in nearly all categories between six months and one year, although not for the two year follow-up. Of note is the fact that while the DASH score improved significantly, it did not return to baseline after two years. Lastly, 15% of the patients had a complication, although all but three were considered minor with tendon inflammation being most common in nine patients.



Standard locking compression plates for open reduction and internal fixation of distal radial fractures.



Postoperative LCP distal radius x-rays. Lateral and AP view.

The combined database

Combining both arms of the implant study provided an extraordinary opportunity to address a number of outcome parameters regarding distal radius fractures, independent of the method of treatment. Our team at the Massachusetts General Hospital in Boston including Dr Sebastiaan Souer, a Dutch PhD student together with Drs David Ring and Jesse Jupiter and AOCID collaborators, identified at least 15 possible topics for further analysis. One notable example was to evaluate the influence of an ulnar styloid base fracture on the outcome of distal radius fractures. Although ulnar styloid base fractures are commonly associated with fractures of the distal radius, their influence on outcome is unclear. Cohorts with and without an untreated ulnar styloid base fracture were compared to observe differences in wrist function and arm specific health status during recovery.

Experience

We are only beginning to utilize this valuable data. Furthermore, the power of this type of collaborative approach is certainly evident in the quality of the data obtained, and will almost certainly result in a higher quality of scientific evidence. We hope that this is just the first of many successful collaborative efforts coordinated by AOCID. Most of all, the interaction with all of the members involved in this project at AOCID has been stimulating and enjoyable.

Many thanks go out to all the participating medical centers whose heroic work in the study and with the collection of data needs to be recognized, since none of this would be possible without them.

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Health economy analyses are increasingly important to document economic aspects of surgical fracture treatment, and are particularly rare in Latin America. AO Clinical Investigation has conducted a retrospective cohort cost-effectiveness study of surgical vs non-surgical treatment of fractures in Chile.

Paula Sotelo and Beate Hanson

Costs and Cost-Analysis in Fracture Osteosynthesis Treatment

Clinical information, direct costs of medical treatment, and the costs of disability compensation were collected for cases of occupational injuries that resulted in spinal, pelvis, distal radius, scaphoid, proximal humerus, diaphyseal tibia or ankle fractures between January 1, 1999, and December 31, 2002. Each case was retrospectively followed for 18 months. A total of 413 patients were included in the study (73.4% male, 51% surgically treated).

Overall, surgical treatment was more expensive compared to non-surgical treatment for all fracture types. This was due to higher costs of surgical treatment and operation expenses and inpatient hospitalization. At the same time, the surgical cases did not have shorter sick leave periods.

The limitations of this analysis are in differences of severity between the surgical and nonsurgical cases. More specifically, surgical cases were more severe than the non-surgical cases.

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We attempted to perform a stratified analysis using the Müller AO Classification of fractures. The stratified analysis showed that surgically treated AO 42-A diaphyseal tibia fractures have shorter sick leave periods with lower indirect costs. These findings corroborate with earlier reports from the literature (Toivanen et al, 2000, and Downing et al, 1997).

Fracture classification is important for proper comparison of fracture treatment costs in non-randomized studies. Regional differences in medical treatment costs and amounts of disability compensation fees limit the transferability of cost-effectiveness findings. Patient-reported outcomes are important dimensions of cost analysis. Further studies in this growing area of fracture treatment research are necessary.

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The following article discusses how AOCID has developed a system to classify long-bone fractures in children.

Theddy Slongo and Laurent Audigé

Development and validation of the new AO Pediatric Comprehensive Classification of Long-Bone Fractures (PCCF)

Introduction

Over the last six years, the AO Classification Supervisory Committee (CSC) coordinated by AO Clinical Investigation and Documentation (AOCID), has been active in setting new standards for the development and validation of fracture classification systems. One of the first successful outcomes is the new AO Pediatric Comprehensive Classification of Long-Bone Fractures (PCCF). Presented here are the main features of this new system, as well as the validation steps that were undertaken during its development.

With innovative treatment options made available for pediatric fractures (eg, elastic intramedullary nail with or without the use of end caps) in the last few decades, it has become necessary to implement appropriate clinical data auditing (quality control) and high quality clinical studies to support the surgeons' decision process. This created an inherent need to develop and validate a comprehensive classification system specifically for pediatric fractures. Initiated by the AO Pediatric Expert Group, and coordinated by the CSC and its AO Pediatric Classification Group, a pediatric comprehensive classification of fractures was developed, taking into consideration the phenomenon of growth and the existing classification. Hence, the current classification proposal is based on the Müller AO Classification for adults and considers child specific relevant fracture features [1–5].

In addition to clinical relevance, scientific validation was paramount. The classification process (ie, fracture diagnosis) should be reliable and valid, therefore it was necessary to start an evaluation early in the development process [6]. As endorsed by the CSC, the development of this classification system successively followed the first two of three research phases recommended by Audigé and coworkers [7] before being considered as validated.

The first development phase involved experienced pediatric orthopedic surgeons who defined a common language to describe pediatric fractures and the process of classification. Four successive pilot agreement studies were conducted to ensure that these terms and process were workable with experts [6, 8]. The second phase involved a web-based multicenter international agreement study involving surgeons with a range of experience [9, 10] to ensure that the system was usable for the non expert surgeon. As these first two phases are completed, recommendations for patient care based on the classification can be developed in the third phase, a prospective clinical study.

The validated classification has been presented at many congresses, has become a standard lecture on AO pediatric courses worldwide, has been published as an appendix in several books [1–3], and will be fully disclosed as a special chapter of the new Fracture and Dislocation Compendium of the Orthopedic Trauma Association (OTA) [1]. In addition, a new classification brochure has been added to this issue of AO Dialogue.

Classification overview

Location

Fracture location is related to the four long bones and their three segments, as well as the special pediatric subsegments. The bones and segments within the bones follow a coding scheme similar to that in adults (**Fig 1**), but the identification of the segments differ. For pediatric long-bone fractures, the end segment has two subsegments: 1, the metaphysic (M) is identified by a square whose side has the same length as the widest part of the physis in question and 2, the epiphysis (E). For the radius/ulna and tibia/fibula bone pairs, both bones must be included in the square. Consequently, the three segments can be defined as:

Segment 1: Proximal: including epiphysis (E) and metaphysis (M) subsegments
Segment 2: Diaphysis (D)
Segment 3: Distal: including metaphysis (M) and epiphysis (E) subsegments

As malleolar fractures are uncommon in children, they are simply coded as distal tibia fractures. For example, the fracture of the medial malleolus is a typical Salter-Harris III or IV fracture of the distal tibia coded as 43.

The original severity coding of A-B-C used in adults is replaced by a classification of fractures according to diaphysis (D), metaphysis (M) and epiphysis (E) (**Fig 1**). This terminology is known and accepted worldwide and is relevant to pediatric fractures. Epiphyseal fractures (E) involve the epiphysis and respective growth plates (physis); the metaphyseal fractures (M) are identified through the position of the square (where the center of the fracture lines must be located in the square) with one side over the physis. For an easier and more accurate application of the squares and thus, a more reliable classification, a series of predrawn squares are copied on a transparency and applied to the anteroposterior (AP) radiographic view (**Fig 2a**). This square definition is not applied to the proximal femur, where metaphyseal fractures are located between the physis of the head and the intertrochanteric line.

Morphology

The morphology of the fracture is documented by a type specific child code and a severity code, as well as an additional code for displacement of specific fractures (**Fig 3**).

Child code

Relevant pediatric fracture patterns, transformed into a "child code", are specific and grouped according to each of the fracture location categories of E, M, or D. Internationally known and accepted child patterns have been considered (**Fig 4**).

Patterns of epiphyseal fractures include the known epiphyseal injuries I to IV according to Salter-Harris [1] using the child codes E/1 to E/4. Other child codes E/5 to E/9 are used to identify Tillaux (two plane) fractures (E/5), tri-plane fractures (E/6), ligament avulsions (E/7), and flake fractures (E/8) (**Fig 4**).

Three child patterns are identified for metaphyseal fractures, ie, the buckle / torus or greenstick fractures (M/2), complete fractures (M/3) and osteo-ligamentous, musculo-ligamentous avulsion or only avulsion injuries (M/7).

Child patterns within segment 2 (diaphyseal fractures) include bowing fractures (D/1), greenstick fractures (D/2), toddler fractures (D/3), complete transverse fractures (angle ≤ 30° - D/4), complete oblique / spiral fractures (angle > 30° - D/5), Monteggia (D/6), and Galeazzi lesions (D/7).

Severity

A grade of fracture severity distinguishes between simple (.1), and wedge (partially unstable fractures with three fragments including a fully separated fragment) or complex fractures (totally unstable fractures with more than three fragments) (.2) (**Fig 5**).

Fracture displacement for specific fractures

Supracondylar humeral fractures (code 13-M/3) are given an additional code regarding the grade of displacement at four levels (I to IV) (**Fig 6**).

Radial head fractures (code 21-M/2 or /3, or 21-E/1 or /2) are given an additional code (I–III) regarding the axial deviation and level of displacement.

I = no angulation and no displacement
II = angulation with displacement less than half of the bone diameter
III = angulation with displacement more than half of the bone diameter

Paired bones

Except for the known Monteggia and Galeazzi lesions, when paired bones (ie, radius/ulna or tibia/fibula) are fractured with the same child pattern, a single classification code should be used with the severity code being used to describe the worst

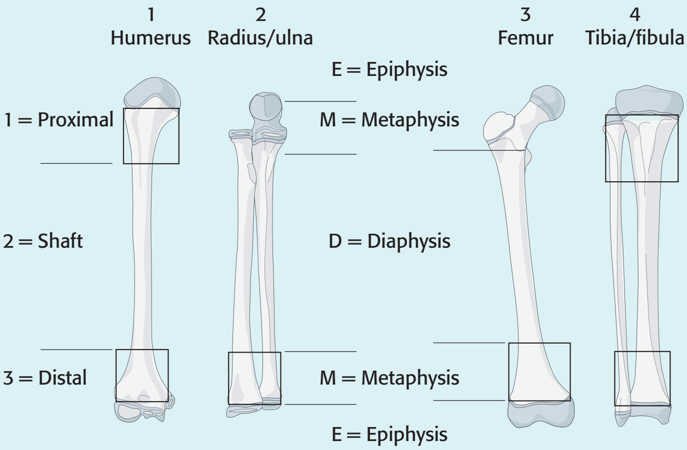

Fig 1 Fracture location related to bone segments and subsegments. For children, the square must be placed over the larger part of the physis.

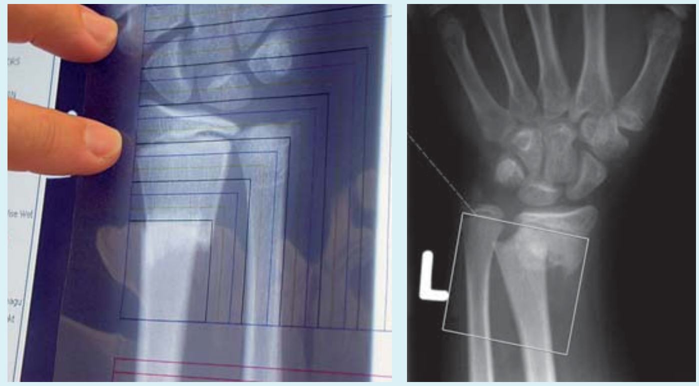

Fig 2 Two possibilities to apply the square definition in classifying a fracture as epiphyseal (E), metaphyseal (M), or diaphyseal (D). The metaphysis is identified by a square whose side has the same length as the widest part of the bone physis on the AP radiographic view. For the bone pairs (ie, radius/ulna and tibia/fibula), both bones must be included in the square.
a) Using a transparency sheet and applied over the x-ray.
b) Drawing a square over the radiographic image directly by computer.

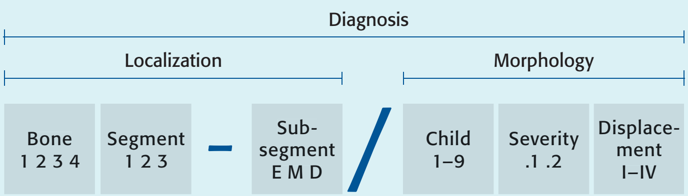

Fig 3 Overall structure of the pediatric fracture classification.

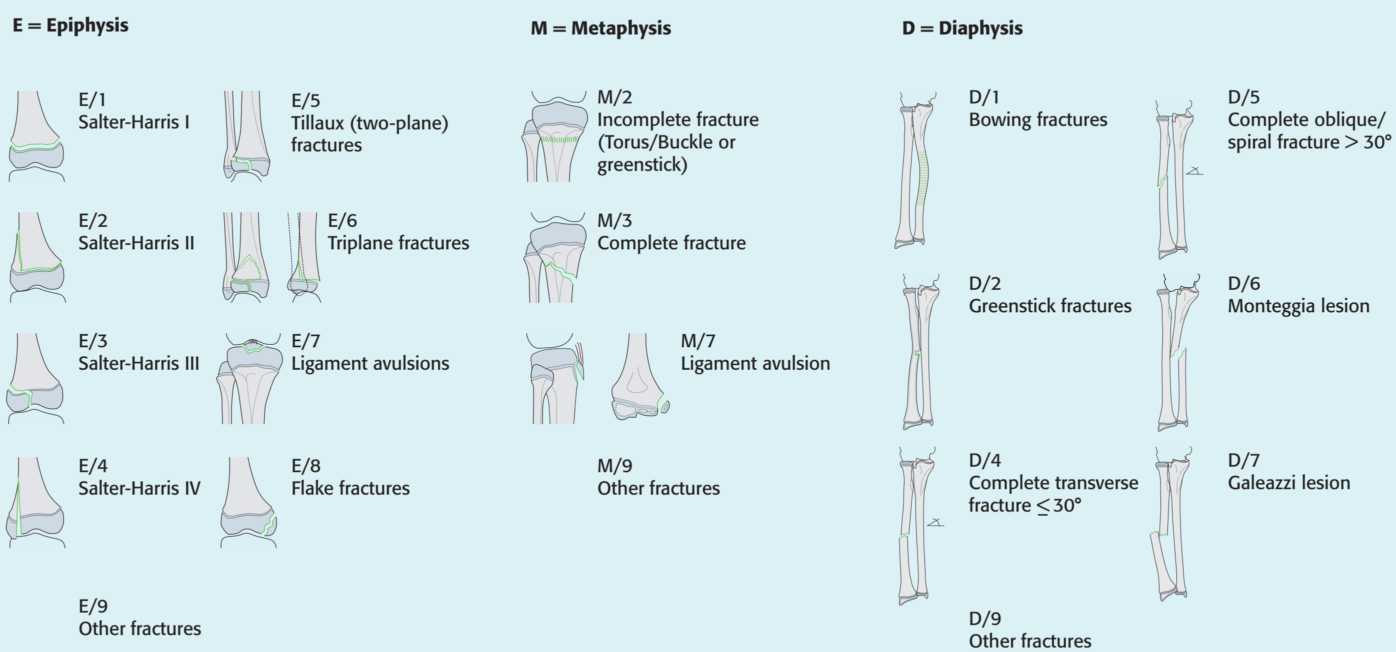

Fig 4 Definition of child patterns for epiphyseal (E), metaphyseal (M), and diaphyseal (D) fractures.

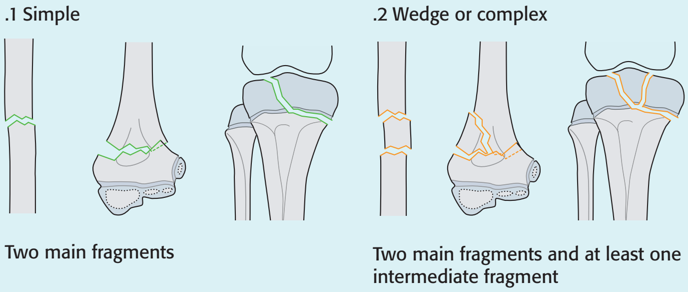

Fig 5 Severity implies anticipated difficulties and method of treatment, not the prognosis.

Fig 7 Example of a supracondylar fracture (a) and a tibia shaft fracture (b).

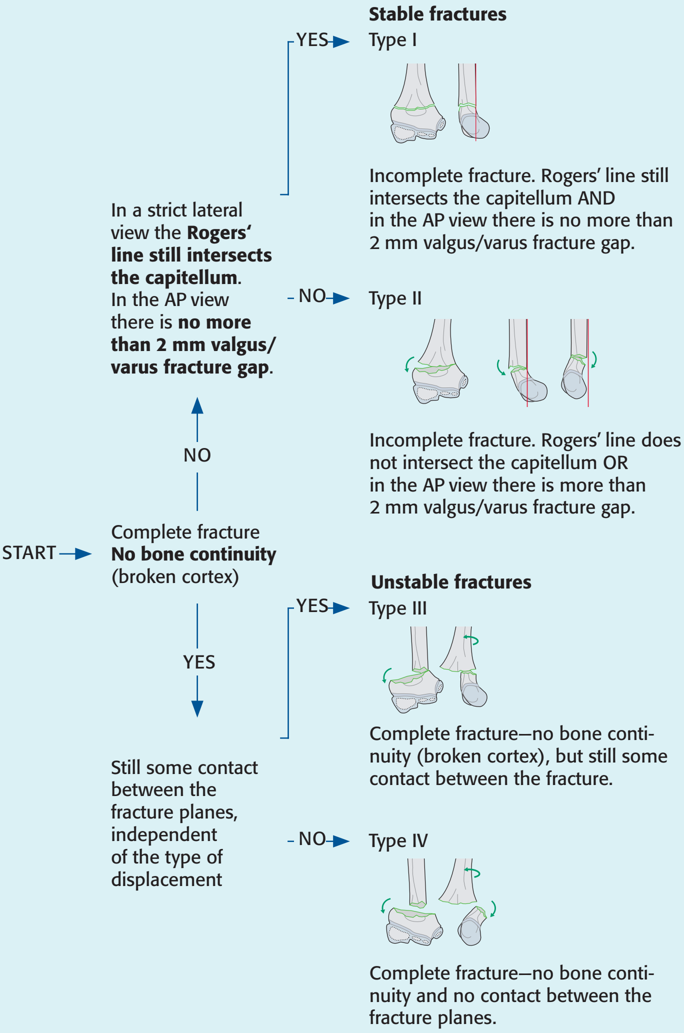

Fig 6 Classification algorithm for coding the displacement of supracondylar humeral fractures.

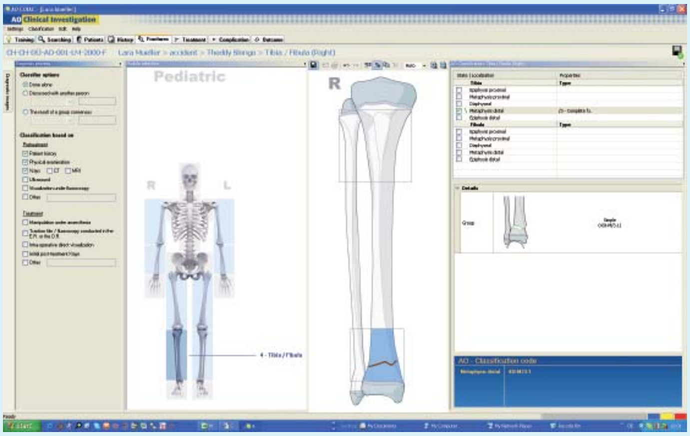

Fig 8 Screen shot of the COIAC version 2.0 software—Comprehensive Injury Automatic Classifier—for the classification of pediatric fractures.

of the two bones. When a single bone is fractured, a small letter describing that bone (ie, "r", "u", "t", or "f") should be added after the segment code (eg, the code "22u" identifies an isolated diaphyseal fracture of the ulna).

When paired bones are fractured with different child patterns (eg, a complete fracture of the radius and a bowing fracture of the ulna), each bone must be coded separately including the corresponding small letter (22r-D/5.1 and 22u-D/1.1). This allows for the detailed documentation of combined fractures of the radius and ulna, or those of the tibia and fibula in clinical studies, so their relative influence on treatment outcomes can be properly evaluated. A list of the most frequent combinations of paired fractures is presented at the end of this chapter.

Some further rules

- Fractures of the apophysis are recognized as metaphyseal injuries.
- Transitional fractures with or without a metaphyseal wedge are classified as epiphyseal fractures.
- Ligament avulsions:
  Intraarticular and extraarticular ligament avulsions are epiphyseal and metaphyseal injuries, respectively. The side of ligament avulsion fractures of the distal humerus and distal femur is indicated by the small letter "u" (ulnar/medial), or "r" (radial/lateral) for the humerus and by "t" (tibial/medial), or "f" (fibular/lateral) for the femur.
- Femoral neck fractures:
  Epiphysiolysis and epiphysiolysis with a metaphyseal wedge are coded as normal type E epiphyseal SH I and II fractures E/1 and E/2. Fractures of the femoral neck are coded as normal type M metaphyseal fractures coded from I to III. The intertrochanteric line limits the metaphysis.

The full classification code therefore includes five or six descriptive entities depending on the use of a code for fracture displacement. Two typical classification examples are presented in **Figure 7**.

Outlook

This AO Pediatric Comprehensive Classification of Long-Bone Fractures (PCCF) has been approved by the AO Classification Supervisory Committee and endorsed by the Orthopedic Trauma Association. While further validation work is ongoing, particularly for the displacement coding of supracondylar fractures, this system has already gained international acceptance. To promote its dissemination, training and use, it has been integrated together with the Müller AO Classification into a software package (COIAC version 2.0 - Comprehensive Injury Automatic Classifier) that is now available to all surgeons (www.aofoundation.org/aocoiac).

Using the software, a skeleton interface provides access to bone specific classification modules, whereby successive drop-down menus and classification options aid the classification and coding process (**Fig 8**). Classification data and additional clinical information can be saved into a relational database that has been further developed to document treatment options and outcomes in a range of clinical settings, as part of the third and last phase of validation.

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Jan Tidermark and Hans Törnqvist

AO Debate
Controversies in Management

Case 1

A 72-year-old active lady (**Fig 1**). Sustained a displaced femoral neck fracture (**Fig 2**) after a simple fall. Preoperative assessment: ASA 2, cognitively intact with SPMSQ 10, independent living with unrestricted walking ability.

Case 2

85-year-old lady (**Fig 3**). Sustained a displaced femoral neck fracture after a simple fall (as in case 1, **Fig 2**). Preoperative assessment: ASA 3, mild cognitive dysfunction with SPMSQ 7, living in an assisted living home, walking is limited to indoor walking with a walker.

Introduction

A hip fracture, especially a displaced femoral neck fracture, is probably the most devastating consequence of osteoporosis in the increasingly elderly population and a major challenge for health care and society. Femoral neck fractures constitute approximately 50% of all hip fractures and 70–75% of the femoral neck fractures are displaced (Garden III and IV) [1].

Some of the remaining controversies regarding the optimal treatment for the vast majority of elderly patients may be partly explained by the long lasting ambition to find a single surgical method to treat all patients with a displaced fracture of the femoral neck. Therefore, many studies have included a broad spectrum of patients of varying age with differing functional levels and risk profiles in order to be able to present results that can be generalized to the entire population of patients with displaced femoral neck fractures. However, the surgical treatment of displaced femoral neck fractures differs from the treatment of many other hip fractures because the available treatment modalities, internal fixation (IF), hemiarthroplasty (HA), and total hip replacement (THR), differ in surgical impact, complications, and long-term outcomes. Consequently each modality has its own unique characteristics, advantages, and disadvantages.

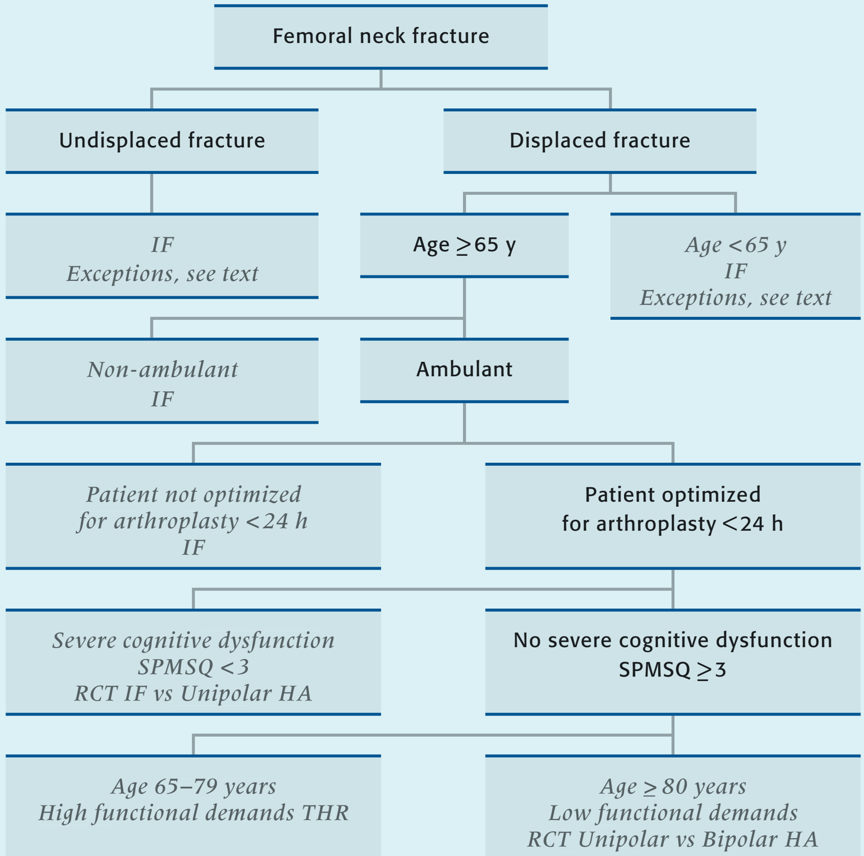
Based on modern scientific data we advocate that the treatment of elderly patients with displaced femoral neck fractures should be individualized, ie, should include all available surgical options and be based on the individual patient's age, functional demands, and risk profile [2, 3].

Patient selection criteria

We currently use the following six patient selection criteria to choose between the different treatment modalities in patients with femoral neck fractures. We will discuss each of these six steps individually (**Fig 4**).

1. Fracture type: ie, undisplaced (Garden I and II) vs displaced (Garden III and IV).
2. Age: ie, < 65 years of age vs ≥ 65 years of age.
3. Walking ability: ie, nonambulant vs ambulant.
4. Anesthesiological assessment: ie, not optimized for arthroplasty < 24 hours versus optimized for arthroplasty < 24 hours.
5. Cognitive function: ie, severe cognitive dysfunction (SPMSQ < 3) vs no severe cognitive dysfunction (SPMSQ ≥ 3).
6. Functional demands reflected by age: ie, age 65–79 years vs age ≥ 80 years.

Fig 1 72-year-old active lady.
Fig 2 Displaced femoral neck fracture.
Fig 3 85-year-old female patient.
Fig 4 Patient selection criteria.



4

Step 1: Fracture type In most studies with an adequate follow-up, the rate of fracture healing complications after IF in patients with undisplaced femoral neck fractures (Garden I and II) is in the range of 5–10% [2] and good results regarding function and HRQoL can be expected [4, 5].
Consequently we perform IF on all patients with undisplaced femoral neck fractures, except for those with symptomatic osteoarthritis (OA) or rheumatoid arthritis (RA) affecting the fractured hip and on patients with pathological fractures.
In displaced femoral neck fractures after internal fixation, the rate of fracture healing complications after IF is considerably higher, being, in most studies with at least two-year follow-up, in the range of 35–50% [6–13]. Moreover, many patients experience impaired hip function and a reduced HRQoL despite an uneventfully healed fracture [4, 5, 11, 12].
Before selecting the treatment modality for patients with displaced (Garden III and IV) femoral neck fractures we continue to step 2.

Step 2: Age The aim of assessing age is to estimate the patient's expected mean survival time. Patients with hip fractures have an increased mortality rate during the first year after the fracture but after one year the mortality rate is comparable to that of the general population. The expected mean survival time in relation to age and gender in Sweden is displayed in Table 1 [14]. These figures give the surgeon an estimation of the requested durability of the chosen surgical procedure in elderly patients.
The rate of fracture healing complications after IF in the younger age group is not extensively reported. Most studies include a limited number of patients after high energy trauma. However, IF is the preferred method for younger patients, due to the patients' longer life expectancy and consequently higher risk for revision surgery after an arthroplasty. Most previous studies have used 65–70 years as the upper limit for IF [7–12, 15], but the optimal age limit is pending. Recently, 55 years has been suggested [13].
We perform IF on patients with displaced femoral neck fractures under the age of 65 except for those with symptomatic OA or RA affecting the fractured hip, those with pathological fractures, and those with severe renal insufficiency and hyperparathyroidism.
Before selecting the treatment modality for patients aged ≥65 years with displaced fractures, we continue to step 3.

Step 3: Walking ability We perform IF on all nonambulant patients because it is the least demanding surgical procedure for the patient. The rate of fracture healing complications in this selected cohort of patients is not well reported, but there are good reasons to assume that the need for revision surgery is lower than in ambulant patients. A primary resection arthroplasty, ie, the Girdlestone procedure, or a unipolar HA may be considered. However, these are more demanding surgical procedures compared to IF and could always be considered as salvage procedures in case of symptomatic fracture healing complications in nonambulant patients.
Before selecting the treatment modality for ambulant patients aged ≥65 years with displaced fractures, we continue to step 4.

Step 4: Anesthesia assessment Ambulant patients aged ≥65 years with displaced fractures, considered by the attending anesthesiologist not to be optimized for an arthroplasty procedure within 24 hours, are treated with IF. The cementing procedure during arthroplasty introduces an increased risk of perioperative complications, especially in elderly patients with preexisting cardiovascular conditions [16], and therefore it is important that the patient's general medical condition can be optimized in the acute setting. Based on the results of previous studies [17, 18] the uncemented Austin Moore HA is only indicated as a salvage procedure after failed IF in extremely frail patients. The modern pressfit uncemented prosthetic stems may be a good alternative but, so far, there is in our opinion no convincing scientific evidence supporting their use in elderly osteoporotic hip fracture patients.
We have chosen a time limit of 24 hours for this preoperative assessment since a longer waiting time introduces an additional risk of complications due to immobilization. There is also a risk that the assessment, even after a longer period of time, will result in nonapproval for arthroplasty and by that time the risk for fracture-healing complications after IF will have further increased. Postoperatively, all patients with displaced fractures treated with primary IF are scheduled for a follow-up visit including a radiographic control at four months and, in case of a fracture-healing complication, the patients are offered an elective arthroplasty.
Before selecting the treatment modality for ambulant patients aged ≥65 years with displaced fractures optimized for arthroplasty within 24 hours, we continue to step 5.

Step 5: Cognitive function We use the SPMSQ for assessing cognitive function. The SPMSQ is a 10-item questionnaire for assessing cognitive function with good validity and reliability and is considered to be quick and easy to administer [19, 20]. We use the cut-off level of fewer than 3 correct answers (SPMSQ <3) or 3 or more correct answers (SPMSQ ≥3) in order to distinguish between patients with and without severe cognitive dysfunction [11, 12, 18, 21]. The patient's cognitive status according to the SPMSQ is routinely assessed at admission to the orthopedic ward by a nurse and always before surgery. Cognitive dysfunction, assessed by using this cut-off level of the SPMSQ, has been reported to be a good predictor of mortality and functional outcome [22, 23].
Patients with severe cognitive dysfunction (SPMSQ <3) are not the target population for THR. This patient cohort has an increased risk of prosthetic dislocations after THR [15] and also a markedly increased mortality rate [18, 22, 23]. For the time being, our recommended treatment for this patient cohort is IF. However, the surprisingly high hip complication and reoperation rates and the inferior outcome regarding walking ability and HRQoL in the HA group in previous studies [18, 24] may partly be explained by the design and uncemented fixation of the Austin Moore HA. In our opinion, the role of a modern cemented HA in this selected patient group needs to be evaluated in future prospective trials. The use of a cemented HA may reduce the reoperation rate although it may not improve the extremely poor outcome regarding ADL, walking ability, or mortality. Therefore, we are currently performing a RCT comparing IF with a modern cemented unipolar HA. Before selecting the treatment modality for ambulant patients aged ≥65 years with displaced fractures optimized for arthroplasty within 24 hours and with SPMSQ ≥3, we continue to step 6.

Step 6: Functional demands reflected by age In a recently published international survey of the operative management of displaced femoral neck fractures in elderly patients, there was some consensus that younger patients should be treated with internal fixation and older patients with arthroplasty. The preferred method for the most elderly was HA, unipolar or bipolar, but there was significant disagreement regarding the optimal management of the active elderly patients between 60 and 80 years of age [25]. Two meta-analyses [17, 26] identified only a limited number of studies [27, 28] evaluating the optimal type of arthroplasty in properly designed RCTs. The overall conclusion was that there was still inadequate evidence to support the choice between different types of arthroplasties.
A recent multicenter RCT comparing IF, bipolar HA, and THR concluded that THR was clearly superior to IF and should be regarded as the treatment of choice for the fit elderly patient with a displaced femoral neck fracture [13]. There also seemed to be an advantage for THR compared to bipolar HA, especially in the longer time perspective, but the authors recommended further trials to verify this finding. This issue has been further evaluated in two RCTs comparing THR and HA published during the last year. Baker et al [29] reported superior short-term clinical results and fewer complications in THR treated patients compared to HA in mobile, independent patients. Blomfeldt et al [21] reported better hip function after THR compared to a bipolar HA at one year in relatively healthy,

Fig 5 Acetabular erosion resulting in a deteriorating hip function.

Age (years)	Gender	
	Female	Male
60	24.9	21.4
65	20.6	17.4
70	16.6	13.7
75	12.7	10.3
80	9.3	7.4
85	6.5	5.2
90	4.4	3.5

Table 1 The expected mean survival time in years in relation to age and gender.

active, and lucid elderly patients randomized to either THA or bipolar HA. Moreover, in this active group of patients with longer life expectancy there is, with the passage of time, a risk of acetabular erosion (**Fig 5**) resulting in a deteriorating hip function.

The risk for dislocation may be one reason why orthopedic surgeons generally hesitate to recommend THR even in active elderly patients [25]. Another reason could be that, in some health care systems, the IFs and HAs are performed by surgeons specially trained in trauma treatment while the THRs are performed by surgeons specially trained in hip arthroplasty and not routinely treating patients with acute femoral neck fractures. However, recent studies [11–13, 21] imply that general orthopedic surgeons with adequate training and using careful patient selection and an anterolateral surgical approach can achieve good results and low dislocation rates with a primary THR.

In conclusion, a primary THR has been shown to yield good results regarding the need for revision surgery, hip function [7–12, 15] and HRQoL [11, 12, 30] for active and lucid elderly patients with a displaced femoral neck fracture. We therefore recommend THR for ambulant patients aged 65–79 years with displaced fractures, optimized for an arthroplasty within 24 hours and without severe cognitive dysfunction (SPMSQ ≥ 3). These patients often have relatively high functional demands and their expected survival time is relatively long (**Table 1**), indicating that they are the target population for THR.

For patients aged ≥ 80 years, ambulant, optimized for an arthroplasty within 24 hours, and with SPMSQ ≥ 3, we recommend HA. These patients usually have lower functional demands and their expected survival time is shorter. A HA provides reasonably good outcome regarding hip function [13, 21, 29] and HRQoL [21] indicating that a HA, with its more limited surgical impact and lower overall dislocation rate [6] constitutes sufficient treatment for these patients. However, there are not as yet, to the best of our knowledge, any RCTs with longer follow-up times comparing a modern cemented unipolar HA to a bipolar HA. The bipolar HA may have some advantages in optimizing offset and reducing acetabular wear that justify its higher cost.

Treatment algorithm

Based on our assessment of patient selection criteria, we currently use the treatment algorithm presented in Table 1. It has been shown to be feasible even in a very busy clinical practice treating approximately 1,200 hip fractures a year. After the introduction of the algorithm our rate of revision surgery has diminished considerably and hopefully our patients benefit from a better outcome.

There are however a few controversies that need to be emphasized and discussed before recommending such a treatment algorithm.

- We are convinced that the anterolateral approach significantly reduces the risk of prosthetic dislocation after arthroplasty in patients with femoral neck fractures. Although some surgeons in our department prefer the posterolateral approach for patients with OA or RA, we all use the anterolateral approach for patients with femoral neck fractures, both primarily and secondarily after failed internal fixation. Compared to the posterolateral approach the anterolateral approach has advantages with regard to the stability of the hip joint, which is of crucial importance in hip fracture patients. Our findings of a low dislocation rate after the anterolateral approach [11, 12, 18, 21] are supported by a multicenter RCT comparing IF, bipolar HA, and THR in which the dislocation rate in patients operated through a lateral approach was 1% compared to 29% in those operated through a posterior approach [13] and also

Fig 6 Patient in case 1 was treated with a THR.

Fig 7 Patient in case 2 was randomized to treatment with a bipolar HA.

by a recent metaanalysis discussing the stability of the hip after hemiarthroplasty [31]. Interprosthetic dissociation may be an added problem for the reduction procedure in certain bipolar HAs necessitating open reduction. In the metaanalysis by Varley and Parker, 12% of the dislocations in the bipolar HA group were interprosthetic dissociations [31]. However, most modern bipolar surgical systems have a more stable construct which will prevent dissociation between the inner and the outer head.

- Cognitive dysfunction should be considered a major risk factor in the selection of the surgical method. Patients with severe cognitive dysfunction are difficult to identify in routine health care without the systematic use of a validated instrument. By using the recommended cut-off level in the SPMSQ and based on one routine assessment made by a nurse at the patient's admission to the orthopedic ward, we have been able to identify patients with severe cognitive dysfunction and predict their poor outcome regarding walking ability, ADL function, mortality, and an increased risk for prosthetic dislocation after THR [23].

Treatment recommendation for cases

CASE 1

According to our algorithm the patient was treated with a THR (**Fig 6**).

CASE 2

According to our algorithm and ongoing RCT the patient was randomized to treatment with a bipolar HA (**Fig 7**).

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Cochin, India
- Principles in Operative Fracture Treatment

September 20–23, 2007
- AO/SEC Course on Principles of Operative Fracture Management for ORP

September 20–22, 2007

Jeju Island, Republic of Korea
- 2nd AOAA Asian Chapter Symposium

October 3–6, 2007

Salzburg, Austria
- AO Fortgeschrittener Kurs

October 16–18, 2007

Cremona, Italy
- Small Animal Principles Course

October 18–20, 2007
- Equine Principles Course

October 29–31, 2007

Santiago, Chile
- Principles in Operative Fracture Management

November 1–3, 2007

Miami, USA
- Principles of Operative Fracture Treatment of Craniomaxillofacial Trauma and Reconstruction

November 3–4, 2007

Karachi, Pakistan
- AO Workshop

November 15, 2007
- Principles of Operative Fracture Treatment

November 16–18, 2007

Rio de Janeiro, Brazil
- Principles in Operative Fracture Management

November 22–24, 2007

Davos, Switzerland
- AO Specialty Course—Osteotomy
- AO Specialty Course—MIS

December 1–4, 2007
- AO Veterinary Course
- Cours AO Avancé pour le traitement opératoire des fractures
- AO Fortgeschrittenen-Kurs für Operative Frakturbehandlung
- AO Specialty Course—Hand
- AO Specialty Course—Pelvic

December 1–6, 2007
- AO Geriatric Fracture Course

December 4–6, 2007
- AO Specialty Course—External Fixator
- AO Specialty Course—CAS

December 5–6, 2007
- AO Craniomaxillofacial Principles Course
- AO Course—Principles in Operative Fracture Management
- AO Course—Advances in Operative Fracture Management
- AO Masters Course

December 9–14, 2007

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