MATHYS
European Orthopaedics

EFORT LUNCH SYMPOSIUM PROCEEDINGS

Current Challenges in Joint Arthroplasty and Possible Solutions

Lisbon, Portugal, 06 June 2019

***Preservation** in motion*

This summary is based on the presentations given during the Mathys lunch symposium in Lisbon, Portugal, 06 June 2019. The content reflects the presenters' professional experiences and personal opinions.

TABLE OF CONTENTS

SYMPOSIUM REPORT

SYMPOSIUM PROCEEDINGS

WELCOME

The 2019 European Federation of National Associations of Orthopaedics and Traumatology (EFORT) Annual Meeting in Lisbon, Portugal, marked the 20th edition of the Federation's dedicated orthopaedic forum. During the proceedings, Mathys featured a lunch symposium that tackled the current challenges and possible solutions in hip, shoulder and knee arthroplasty, with experts **Karl Stoffel, Joseph Baines, Damian McClelland, Stefan Eggli and Chairman Andreas Niemeier** all stepping up to the podium to share their insights with the audience.

HIP

ACETABULAR BONE QUALITY AS A PREDICTOR OF THA SURVIVAL AND SUCCESSFULNESS OF REVISION SURGERY

Karl Stoffel
Professor, MD, PhD – Basel, Switzerland

Proceedings began with Professor Stoffel, who explored the impact of acetabular bone quality on fracture, cup loosening and stress shielding in total hip arthroplasty (THA). Whether or not **bone quality impacts the rate of intraoperative occult acetabular fractures** was Professor Stoffel's first key focus. In the literature, an 8% fracture rate of cementless cups had been reported (Clin Orthop Relat Res. 2017;475:484–494; Int Orthop. 2019;43:1583–1590), occurring primarily in the superolateral aspect of the acetabular. All told, five out of six occult fractures are likely to require revision (Int Orthop. 2019;43:1583–1590).

«So what is the influence of the bone quality on acetabular fractures?»

Professor Stoffel revealed that risk factors include osteoporosis (J Arthroplasty. 2011;26:1570.e17–9), rheumatoid arthritis (Arch Orthop Trauma Surg. 2012;132:535–46) and Paget's disease (World J Orthop. 2017;8:357–363).

«There is one more factor which is probably more important than the bone quality: implant geometry.»

Indeed, Hasegawa et al. (Clin Orthop Relat Res. 2017;475:484–494) showed a significant risk of peri-implant fracture when using spherical, self-locking cups, whereas Haidukewych et al. (J Bone Joint Surg Am. 2006;88:1952–6) found that elliptical cups in particular were at risk of acetabular fractures in more than 7,000 patients.

Turning to bone quality in the presence of a certain **type of osteoarthritis** and its influence on late outcomes, Professor Stoffel noted data by Kobayashi et al. (Lancet. 2000;355:1499–504) who looked at hypertrophic, normotrophic and atrophic osteoarthritic hips, determining that atrophic osteoarthritis had the most significant risk of failure. As they write, the acetabulum might not have been strong enough to prevent failure, fatigue or collapse of the cancellous bone, which could lead to socket loosening.

«Obviously the structure of the cancellous bone is an important factor for the success of the cup itself.»

In terms of **osteoporosis**, Nixon et al. (J Bone Joint Surg Br. 2007;89:1303–8) demonstrated that poor bone quality was a predictor of loosening in cemented total hip replacements. Finnilä et al. (Acta Orthop. 2016;87:48–54) looked at migration of uncemented acetabular cups in female THA patients with low systemic bone mineral density (BMD). They identified that patients with normal BMD did not show a statistically significant cup migration after the settling period of three months, while patients with low BMD had a continuous proximal migration between three and 12 months ($p = 0.03$).

Migration of up to 0.2 mm proximally was shown, with Professor Stoffel, adding: «You may ask yourself, is it relevant, just 0.2 mm of migration?» The answer is yes, according to Pijls et al. (Acta Orthop. 2012;83:583-91), who found an early association between cup migration and late revision in THA, and especially if the migration was greater than 0.2 mm.

Moving on to the topics of **stress shielding and secondary bone loss** – something which Professor Stoffel has experienced a great deal of first-hand – the question as to what triggers remodelling of the bone behind the acetabular cup remains unanswered.

«In order to understand this question, first we have to look at the transmission of load in the hip joint.»

Widmer et al. (J Arthroplasty. 2002 Oct;17:926–35) showed load transfer in three main areas – the ischial, pubic and ilial facet – while the rim and central areas were not loaded substantially. Manley et al. (Clin Orthop Relat Res. 2006;453:246–53) looked at potential bone loss in acetabular structures following THA, revealing that horseshoe-shaped cups loaded the acetabular structures more effectively than hemispherical designs.

Maximum compressive stress is reduced in trabecular bone behind the cup if you use a stiff cup. The more elastic the cup is, like in cemented cups, the higher the peak stress is, and is distributed over a larger area. Manley et al. (Clin Orthop Relat Res. 2006 Dec;453:246-53) also found that bone remodelling is stimulated if the cup has increased stiffness (Figure 1).

Hulskes et al. (Clin Orthop Relat Res. 2006;453:246–53) found that with stiff cups, the main load is not transferred through the cancellous bone, but rather through the rim.

«So the next question is, if you put in a cup, is it true that you have reduction in bone density behind the cup, but increased density of cortical bone around the cup?»

This was proven by Pitto et al. (Clin Orthop Relat Res. 2008;466(2):353–358), who used CT scans to show that in 20 modular cups (1–3 year follow-up), the increase in cortical bone density was an average of 3 %, whereas there was an 8–33 % drop in density of supra-acetabular cancellous bone.

«The decrease in density was significantly higher the stiffer the cup was.»

Similarly, Digas et al. (Acta Orthop. 2006;77:218–26) showed a decrease of BMD with the use of modular, stiff cups, with Stepniewski et al's (J Arthroplasty. 2008;23:593–9) post-mortem analysis finding that bone resorption was mainly medial to the cup, decreasing more proximally.

«Therefore, in THA when stiffer cups are used, less load transfer is through the cancellous bone, and more through the cortical rim.»

There is decreased BMD in the cancellous bone area, and changes are more pronounced the stiffer the cup is.

But does stress shielding also cause hip pain? Professor Stoffel underlined that it is now known that mismatched E-modulus of femoral stems causes thigh pain in as many as 18 % of cases (J Bone Joint Surg Am. 1988;70:337–46). This, he added, might also be one reason why some patients suffer residual groin pain after THA when a stiff cup is implanted. However, there is currently no literature to prove this statement.

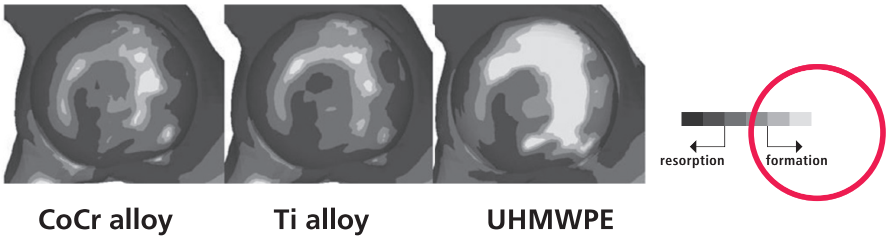
However, when looking at the New Zealand Joint Registry (www.nzoa.org.nz/nz-joint-registry), nearly 22 % of all the patients have had a revision because of any kind of pain. Perhaps it is partially due to the mismatch of different stiffnesses of cups and stems?

Offering his conclusions for the audience, Professor Stoffel reframed the important points discussed.

«Acetabular bone quality impacts risk of occult fracture at the time of surgery, and cups in patients with an atrophic form of osteoarthritis and severe osteoporosis have a higher risk of cup failure. Stress shielding over years influences the bone quality around the cup itself and is an important factor in case of revision surgery.»

«So what can you do as a surgeon? I think there are probably two key things you can do. You can try to reduce the risk of intra-operative acetabular fracture by either cementing in a cup or using a cementless hemispherical cup, and you can possibly reduce the amount of stress shielding / bone resorption by using a low-stiffness cup.»

Acetabular bone quality at the time of the 1° surgery



- Bone remodeling stimulus increases with decreased stiffness of the cup
- PE cup highest stimulus

Source: Manley MT, Ong KL, Kurtz SM: The potential for bone loss in acetabular structures following THA. Clin Orthop Relat Res. 2006 Dec;453:246-53

FIGURE 1.

PRESERVATION OF ACETABULAR BONE STOCK IN THA

Joe Baines
LMS, FRCSEd (T&O) – Glasgow, United Kingdom

Following Professor Stoffel's presentation, Mr Baines discussed how to preserve acetabular bone by taking the audience through the three surgical pillars of preservation, restoration and replacement.
Beginning with preservation, Mr Baines further sub-divided this into three components: the surgeon (and their tools), the implant (and its stiffness) and the patient's bone stock. The reamer in the hand of the surgeon gives great power, he stressed, which should be exercised with control.

«Conservative reaming is the first step in bone preservation, and probably the most important – certainly in primaries and revisions.»

As an example, he showed a straightforward hip replacement where too much bone had been removed, leading to osteopaenia and likely problems for later revision (Figure 1). Similarly, he showed a 5-year postoperative modular cementless cup where a halo of osteopaenia was evident (Figure 2).

«You can see the concentration of stress in the cortical bone [arrow]. If that cup needs revision one day – which it might because its placement is not mechanically correct – we will have a problem.»

Echoing Professor Stoffel's message that increasing cup stiffness leads to more stress shielding, Mr Baines presented a 10-year follow-up radiograph of a ceramic-on-ceramic cup (Figure 3).

«There is no restoration of bone, in fact bone has been lost.»

«Is this osteolysis or osteopaenia... These ceramic cups don't create particles, so it should be osteopaenia.»

Osteopaenia was also evident around a large head metal-on-metal replacement (Figure 4), he added, noting that subsequent revision with an elastic cup led to restoration of bone stock within a year.

Similarly, in a bilateral hip replacement using a stiff and an elastic cup, Mr Baines noted lower bone density was clearly evident in the stiff cup.

«So the stiffness of the cup seems to have an effect.»

Turning to bone restoration, Dr Baines touched on the process of bone restoration after elastic cup implantation. Referring to case examples, he demonstrated a positive response of bone graft to elastic loading, with full graft incorporation and remodelling creating «a new socket» clearly illustrated on X-ray after two years. On the contrary, metal-backed cups showed the usual halo of osteopaenia in a similar situation. However, graft resorption and collapse remain a risk, as shown in one of his bulk allograft revision cases.

«We don't get it right every time, and collapse is a concern.»

FIGURE 1.

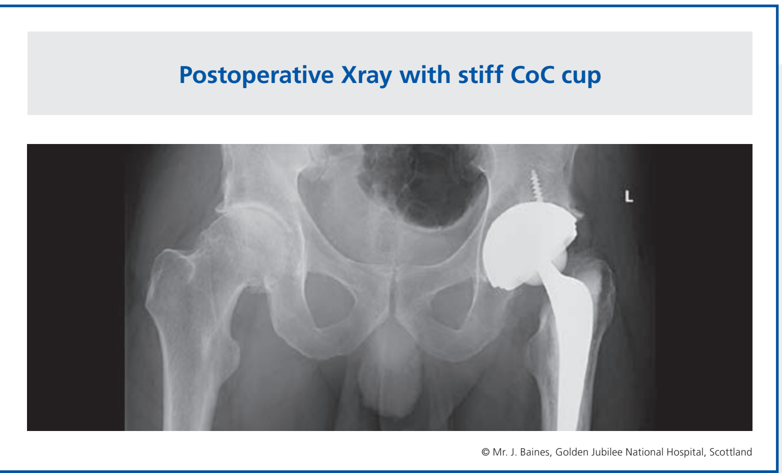


FIGURE 2.

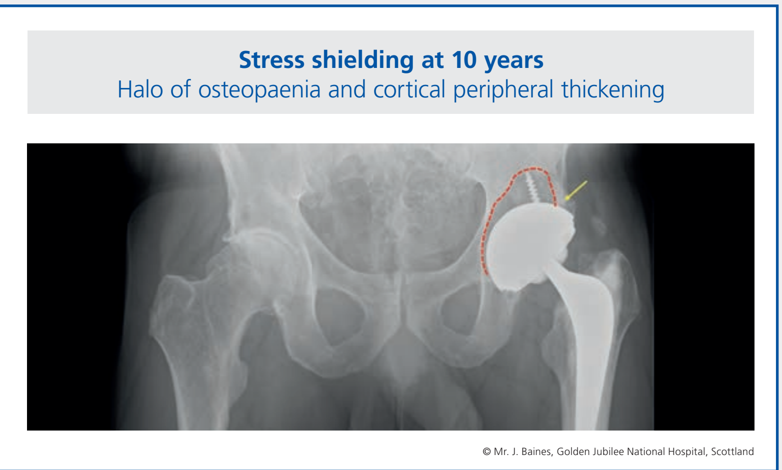


FIGURE 3.
A halo of osteolysis can be seen, or perhaps an overlap with osteopaenia. Concentrated stress on the cortex is evident (arrow).

«So, how do we prevent this? We replace.»

Replacement of bone with prosthetic augments was the third and final challenge laid out by Mr Baines, who shared his extensive experience using Mathys' cementless monoblock RM Pressfit cup. «First of all, to put this in context I will say that I have implanted more than 2,000 RM Pressfit cups over the last 10 years.

«I've approached my journey with this cup like a test pilot; trying to test the limits of what is possible with this prosthesis.»

One novel method for reconstructing collapses used by Mr Baines involves cutting the RM Pressfit in half to fashion an elastic customisable augment. The cup fragment is fixed to the acetabular defect, and the augment is then shaped with acetabular reamers, thus creating a new socket. A new cup is inserted underneath, achieving excellent fixation.

«The RM Pressfit is an excellent asset for reconstruction.»

Mr Baines presented several key case examples using this new augmentation concept. First he presented a female patient, living without a hip following an arthroplasty 40 years previously, who requested a reimplantation in her 70s.

«Could we use an RM Pressfit for this? There was a lot of shortening, lengthening and acetabular augmentation required, but yes we could, and this lady is now delighted with her new hip!»

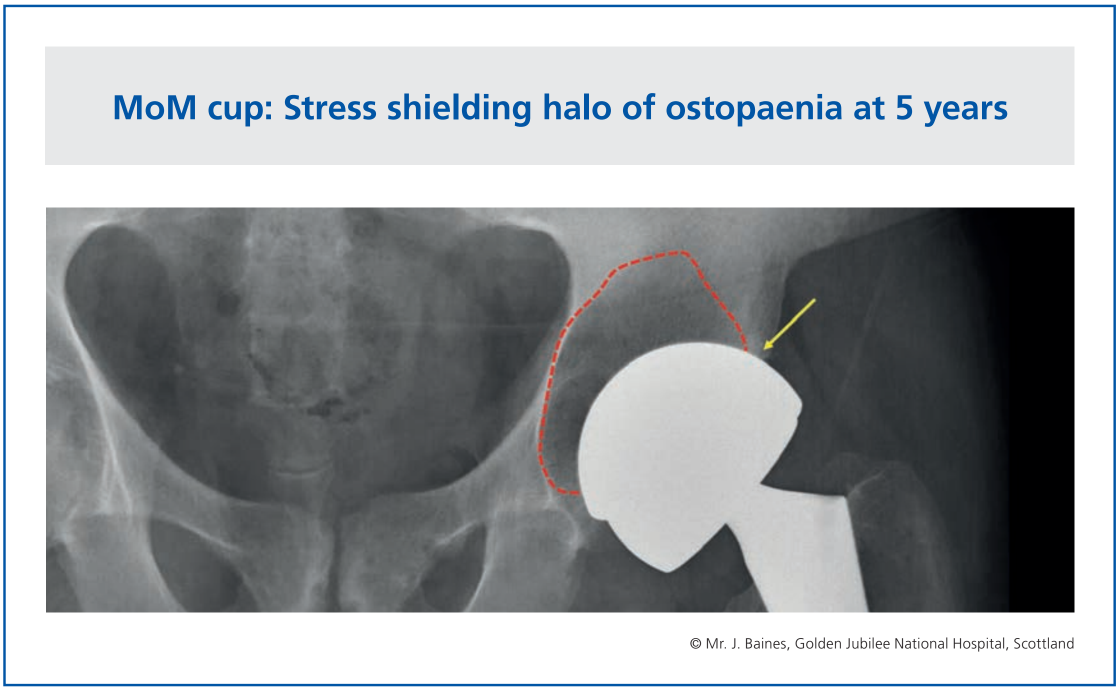


FIGURE 4.

Mr Baines showcased four different applications of the elastic RM augment concept for both contained and segmental acetabular defects. He illustrated that this technique can be used with an RM-Pressfit cup underneath (top left) (Figure 5), an RM-Pressfit cup with a metal-backed modular cup (top right), with a cage (bottom left) which can be reamed and drilled through (like bone, but without risk of collapse like bone) or a cemented cup with an RM-Pressfit augment which can be used with a cemented cup on top (bottom right).

«I have shown you some pretty extreme augment and graft cases, and this cup performs very well in these complex situations, so therefore, how would you not trust it for your routine hip replacements?»

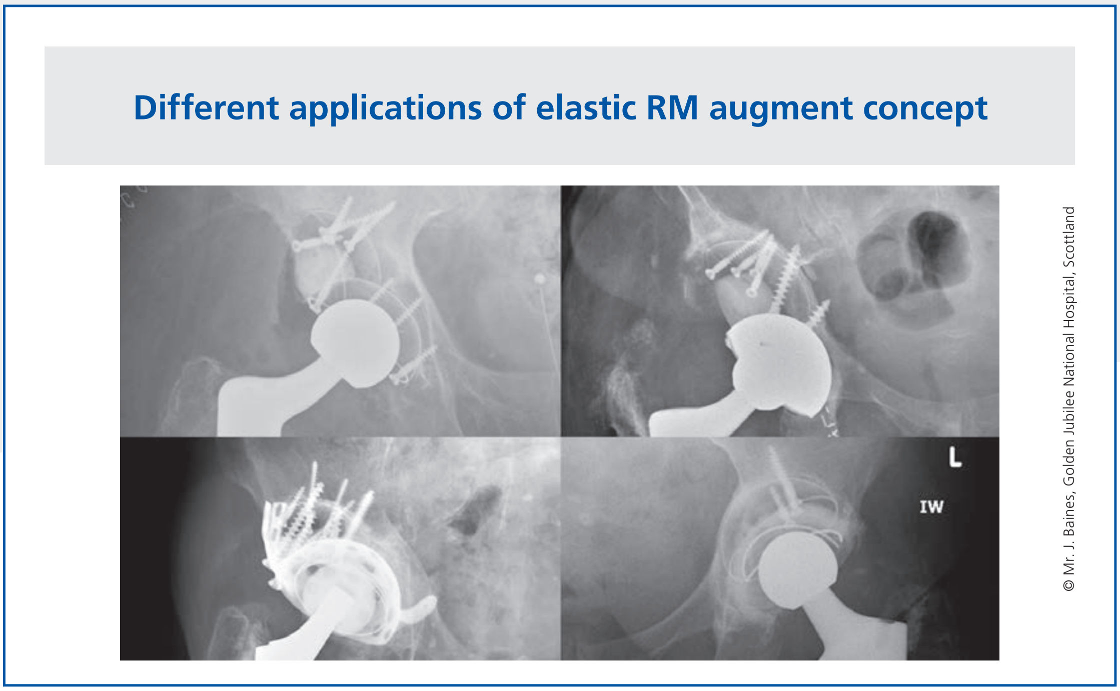


FIGURE 5.

SHOULDER

ANATOMICAL GLENOID REPLACEMENT: STILL AN UNSOLVED ISSUE

Andreas Niemeier
Professor, MD – Hamburg, Germany

Professor Niemeier opened the session on shoulder replacement with an exploration of the unsolved issues in anatomical glenoid replacement. He began with a typical total shoulder arthroplasty (TSA) case example – a 54-year-old woman with primary osteoarthritis, an intact rotator cuff and a B1 glenoid with a little bit of posterior decentralisation.

«She had large osteophytes, bad range of motion and constant night pain.»

Postoperatively, a good cement mantle could be seen, with absolute anatomical reconstruction of the humeral head, good soft tissue balancing and an intact cuff.

At six months, the patient recovered well, demonstrating good relief from pain, good function and with the ability to work and exercise. However, revisiting the case at one year revealed very evident radiolucency behind the glenoid, albeit not around the pegs (Figure 1).

Radiolucent lines occur regularly in cemented glenoids, he went on, no matter whether keels or pegs are used, but they are usually asymptomatic.

«The problem occurs when the radiolucent line goes around the anchorage in the glenoid vault, i.e. around the keel or pegs.»

Then they can become symptomatic, and cause pain and compromised function.

«The problem with anatomical glenoid revision is that it is often technically difficult. Defects are not simple and centrally contained; they are often peripheral and uncontained (Figure 2). Then it is difficult and sometimes even impossible to revise with predictable results.»

It has been long known that symptomatic glenoid loosening occurs at a rate of 1.2 % per year, with surgical revision averaging 0.8 % per year (J Bone Joint Surg Am. 2013;95:2205–12). «The younger the patient, the earlier the failure, according to all world-wide shoulder registries and long-term studies,» commented Professor Niemeier. «In addition, primary glenoid pathology is very variable, and requires more than one standard implant. That is why it is important to choose the right implant for the right patient in the first place.

«Might it be better to not use a glenoid, to avoid failure? Certainly not. It has been well accepted for more than ten years that primary hemi-shoulder arthroplasty (HSA) as well as conversion of failed HSA to TSA yields inferior results to primary TSA.»

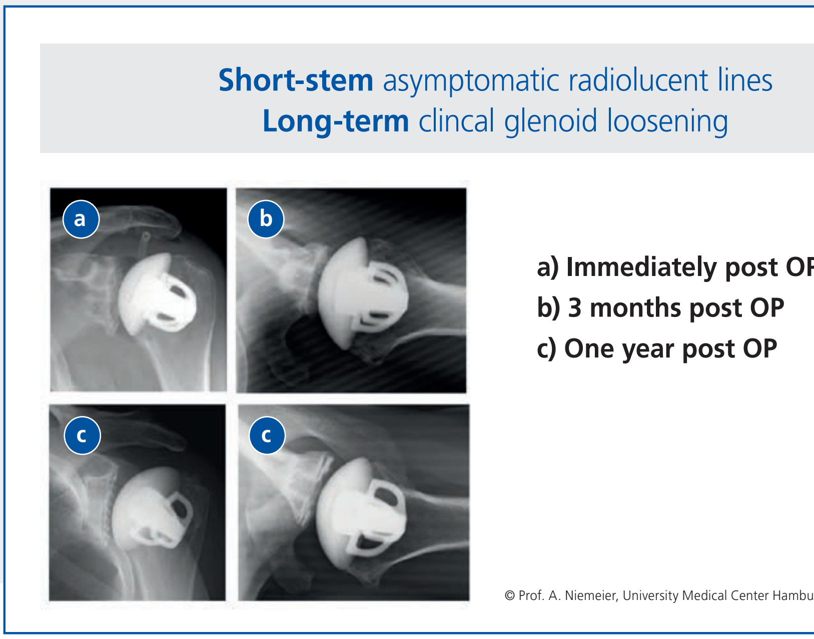


FIGURE 1.

rg-Eppendorf, Germany

Illustrating the difficulty of conversion from HSA to TSA, Professor Niemeier showcased a 49-year-old patient, 13 years after humeral head resurfacing (hemi) due to post-traumatic avascular necrosis. Typical glenoid erosion with medialisation and cranialisation of the centre of rotation was evident (Figure 3).

«If we reconstruct and put in a secondary glenoid, that can be very technically challenging.»

«We have contract soft tissues, and thus often we have issues with offset (a change to a smaller head size may be required) – this means a compromise in anatomical humeral head reconstruction and glenoid anchorage may be difficult as well; the glenoid may not be in the perfect place.»

A major challenge that remains is glenoid replacement in the young (< 50 years), Professor Niemeier continued: Anatomical HSAs do have a high rate of revision in young patients; the Australian Shoulder Registry shows a 10 % rate of revision after two-and-half years.

But, if we go the other way and say we'd rather use a glenoid component in the young, then not only do we have an exceedingly high rate of loosening (10 % at 5–6 years, 20 % at 8 years) but also the revision challenge remains.

«One of the reasons may just be mechanical loosening, because young individuals want to fully use their shoulders. If they are asymptomatic they forget, and thus don't accept any reason why they should not.»

There is also the 'rocking horse' phenomenon, he went on, due to the natural translation and natural kinematics of the shoulder, which leads to mechanical failure of glenoid anchorage.

One solution may be a more kinematic implant design, which puts less stress on the anchorage in the glenoid vault. Another way to go may be new materials – those which avoid transloading the stress directly to the anchorage – or those that help with better bony fixation, such as hybrid technologies (metal-coated polyethylene), better cementing technique or metal-backed glenoids.

«The third point that we need to consider carefully – and this really does not come out well in registry data – is how many of those failed glenoids in the young were those which, a priori, had posterior subluxation and glenoid deficiency?»

Severe retroversion (35 or 45 degrees) with large posterior defects requires reconstruction to restore the glenoid, stressed Professor Niemeier, and cannot be handled effectively with anatomical implants.
But the question is, if this retroversion is mild – if it is not 45 degrees, if it is 25, 20 or perhaps 15 – we do not really have large numbers on long-term outcomes using anatomical implants.

Professor Niemeier added his take-home messages for the audience: «Young patients have high demands; no glenoid is not a good idea; high rates of glenoid failure are seen in particular in those younger than 55, and more durable bony fixation should be a priority in the future, no matter how we will manage to achieve this goal.»

«New materials and more physiological kinematics may help, and static posterior subluxation and bony deficiency are really topics which demand more research.»

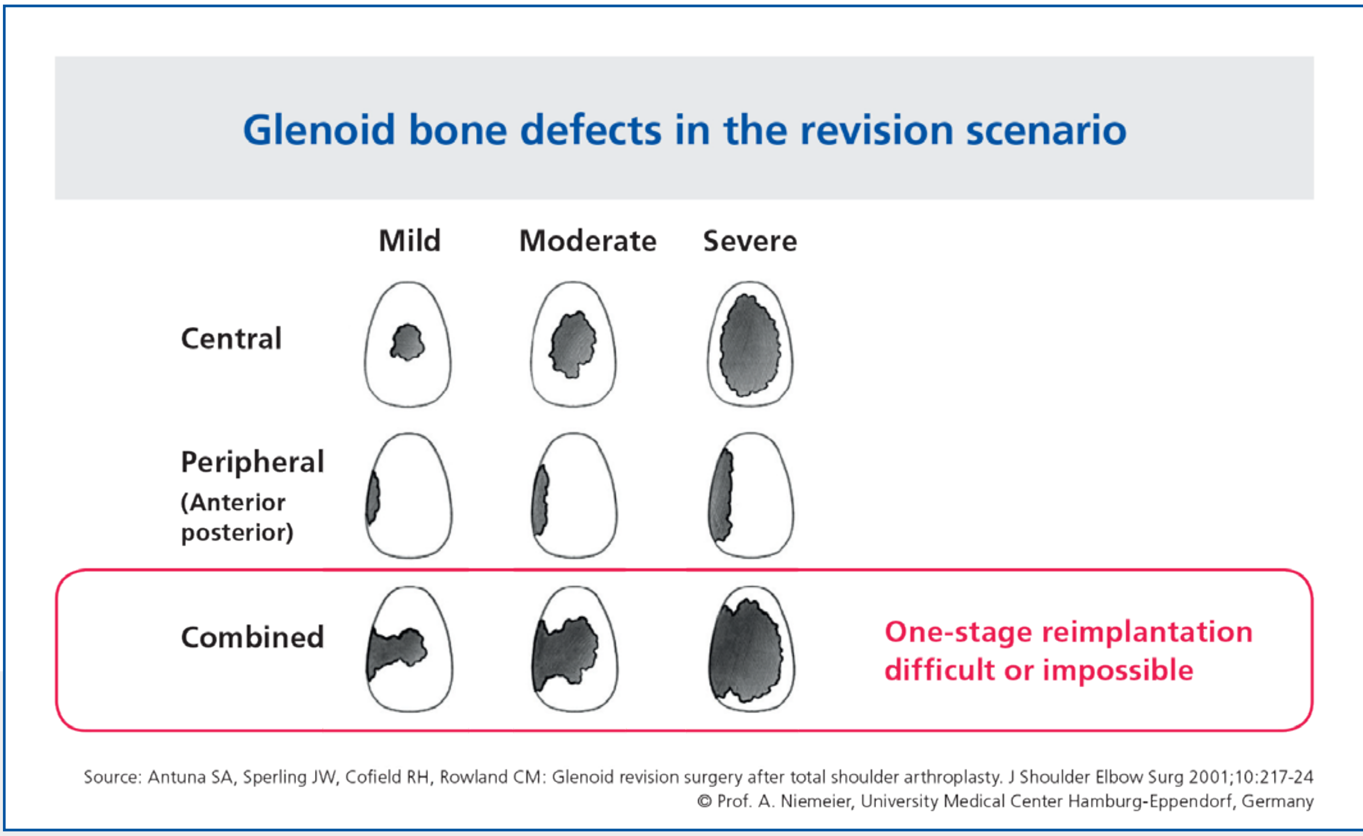


FIGURE 2.

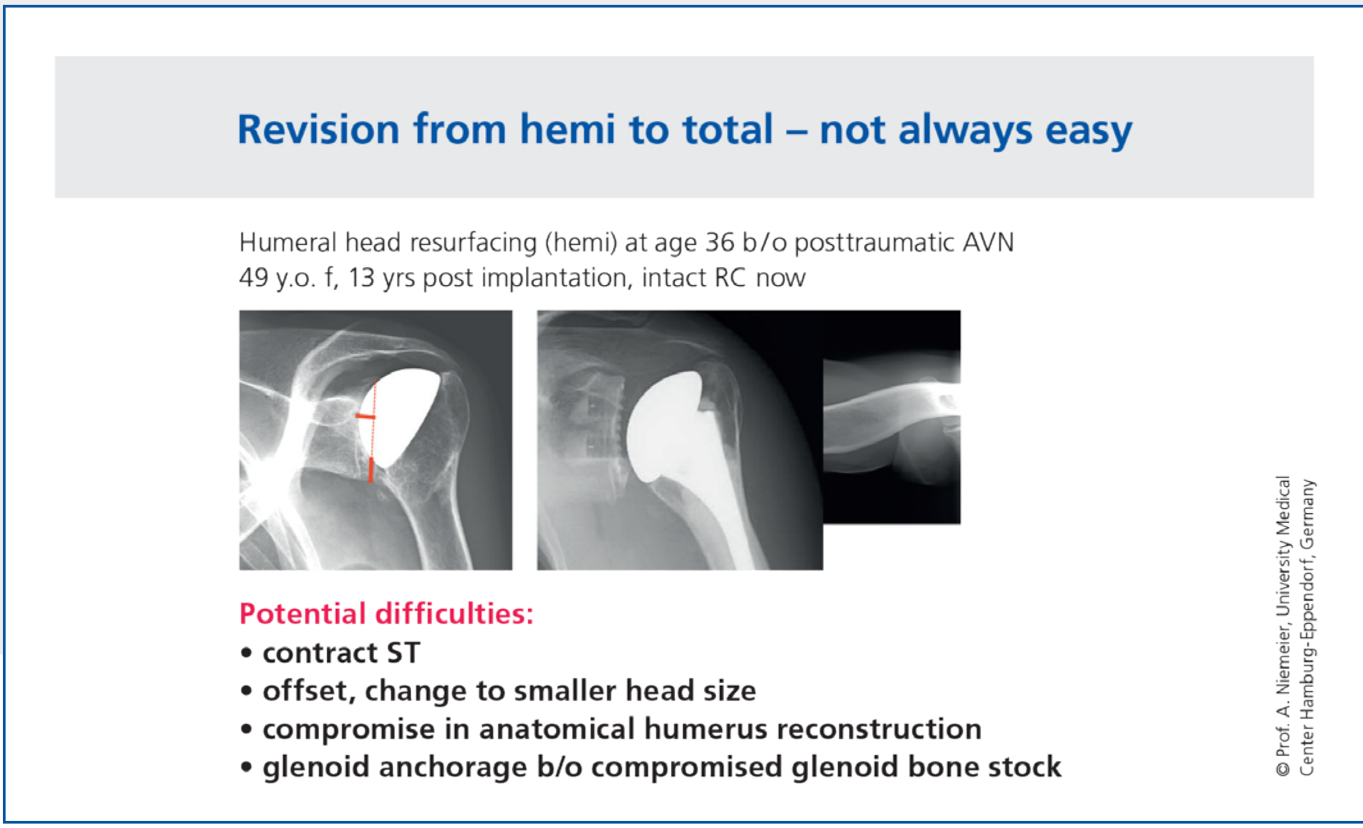


FIGURE 3.

CLINICAL IMPORTANCE OF ANATOMIC HUMERAL RECONSTRUCTION: IMPACT ON KINEMATICS AND GLENOID LOOSENING

Damian McClelland
MD – Stoke-on-Trent, United Kingdom

An accurate, correctly performed osteotomy is one of the most important components in anatomic humeral reconstruction, providing optimal outcomes for sizing, position and height of a prosthesis. This was emphasised in Dr McClelland's message, which walked through his experience in osteotomy and total shoulder arthroplasty (TSA) using the Affinis Short-stemmed total shoulder prosthesis from Mathys.

The Affinis Short, which has been utilised in Dr McClelland's native UK for 6.9 years, has shown exponential rise in usage during that time.

«The rate of loosening and the rate of failure are very low,» he said, adding: «revision rates are significantly better than those published for other prostheses.»

As such, the Affinis Short continues to be the number one anatomic shoulder replacement in the UK, he detailed, and the number one stemless shoulder replacement in Australia.

In his presentation, Dr McClelland focused on three key areas of prosthetic placement: osteotomy and version, sizing and height.

«However, we can consider it as one topic, not three, because if you get your osteotomy right, everything else will follow and it becomes a relatively straightforward procedure.»

The traditional method of performing an osteotomy, he began, is using an intramedullary guide. The offset may differ for every individual, however, and therefore

using an intramedullary guide may lead to an incorrect osteotomy position.

«If you use a short or a stemless device then this can avoid those problems as no intramedullary positioning guide is needed.»

He added that in order to get an osteotomy in the right place, one needs to get the exposure right. To do this, the first key lies with osteophytes.

«If you look where the humeral head was initially, you need to expose this by removing all the osteophytes.»

«The only way you can get your alignment right is to be able see all the way round the back of the humeral head to assess the version.»

He added that in order to do this, structures such as the humeral ligaments and capsule can be removed.

«Then you can get the version correct for that patient, because every patient is different.»

In the literature, retroversion ranges from 0 to 55 degrees, so blanket use of (standard) 30-degree retroversion for shoulder replacements will mean the vast majority of patients will be getting the wrong version for themselves. As a solution, Dr McClelland stressed that the easiest way to assess a person's osteotomy angle is to look at the bicipital groove (Figure 1).

«That makes it very easy. When you dissect down to the humeral head, you find the bicipital groove, if you orientate the arm so that the bicipital groove points forwards, the humeral head is pointing towards the glenoid. That is that person's osteotomy angle.»

For a stemmed replacement, a 135-degree cut tends to be performed, using traditional version and angulation devices. The easiest way to find out where the base of the articular surface is to see where the concavity becomes a convexity. However, he cautioned that when using a 135-degree cutting method, the result will be an oval-shaped cut surface, and thus a circular head will not fit correctly on the cut surface (Figure 2).

«If you take a slightly steeper cut, the result you tend to get is a circular cut surface, and this will give you a circle on which to place your circular anatomic humeral replacement.»

«In performing an anatomic shoulder replacement we are hoping to replace the shoulder's original centre of rotation. If you make your cut too flat, as in a 135-degree osteotomy, what you tend to do is move the centre of rotation distally and laterally.»

Restoring the original centre of rotation is one of the main aims of the process, Dr McClelland went on. In an arthritic shoulder, assuming for the degeneration of the humeral head and some collapse, performing the osteotomy in this way is likely to restore a normal centre of rotation.

Retention of normal centre of rotation can be ascertained by looking at the so-called Shenton line of the shoulder, he went on. If a cut is made in the wrong place, noted Dr McClelland, the line is lost, and the centre of rotation is lowered. Crucially, as a result, the humeral head rises, and impingement of the polyethylene occurs on the humeral neck, and osteolysis develops, he added.

Turning briefly to sizing and height of the stem, Dr McClelland detailed that every short stem is different; each will have a different depth for a given diameter. It is important to realise that for whichever stem you are using, you need to know what the anterior-posterior diameter is, what the superior-inferior diameter is and what the depth of that implant is.

«For sizing, the easiest way is to take the front-to-back sizing, because then you are unlikely to oversize the implant.»

«But again, if you get the correct osteotomy, this will lead to the correct size, position and height. Everything falls into place.»

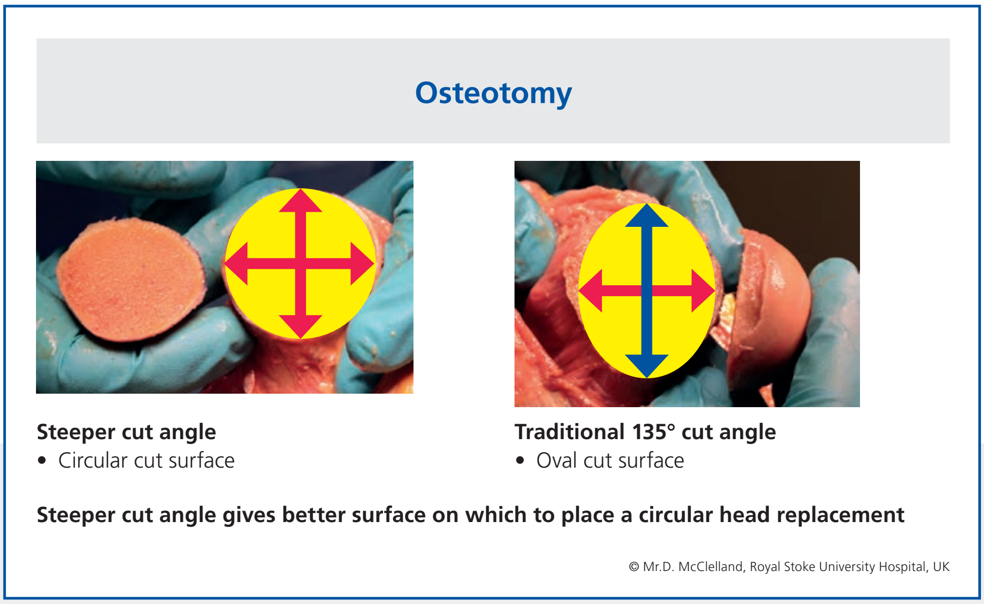


FIGURE 1.

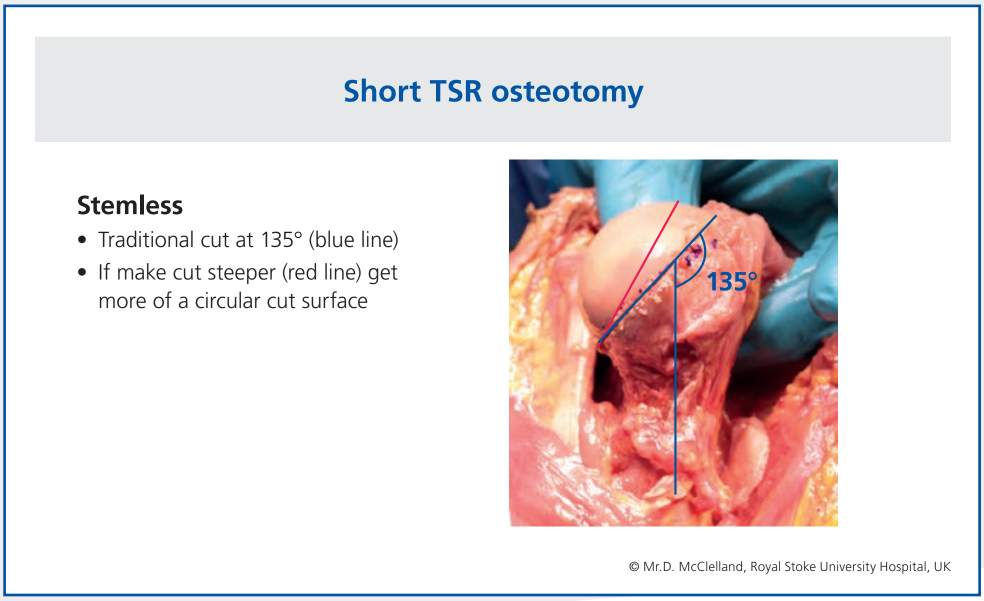


FIGURE 2.

KNEE

IS IT DESIRABLE TO REPLICATE NORMAL KNEE KINEMATICS IN TKA TO IMPROVE PATIENT SATISFACTION?

Andreas Niemeier
Professor, MD – Hamburg, Germany

Better understanding of normal knee kinematics will be essential in improving outcomes in total knee arthroplasty (TKA), but current knowledge has a long way to go, attendees heard as Professor Niemeier stepped up to the podium for the second time.

«The reason why we are talking about kinematic alignment today is because 15–20 % of patients are unsatisfied,» he said. «And we wondered, could we improve this group by more closely reproducing some of the aspects of natural kinematics?»

Diving straight into the mechanisms of normal knee kinematics, Professor Niemeier outlined three main axes at work: flexion-extension of the femoral condyles, the rotational axis of the patella and the rotational axis of the tibia.

«The relation between the rotational axis of the patella and the flexion-extension axis of the femoral condyles varies individually depending on the degree of flexion of the knee,» he noted. «And there is large individual variation between this distance depending on the position of the knee.»

Physiologically, movement around the rotational axis around of the tibia is classed as a«pivot-shift» or «rollback,» with medial and lateral contact points reacting differently to weight-bearing and degrees of flexion. For example, as shown in Figure 1, in deep flexion (i. e. 150 degrees) there is almost no contact between the femoral condyle and the tibial plateau.

KINEMATICALLY- VS MECHANICALLY-ALIGNED TKA

«Having reviewed these basic thoughts about knee kinematics, it becomes clear that this is actually very complex and individually determined, and it really depends on knee joint-loading and degree of flexion.»

He added that physiological kinematics of a healthy knee will never be reproduced after implantation of symmetric implant components in classical neutral mechanical alignment.

«So what we are doing here is totally altering knee kinematics.»

But the fact is, he added, knee kinematics are largely determined by the individual 3D-morphology of the distal femur (Clin Orthop Relat Res. 2007;461:238–44). As such, he stressed that, even if a joint line is reconstructed well, it can deviate significantly from neutral mechanical alignment. In other words, symmetrical bicondylar femoral and tibial implants are not designed for kinematic alignment, leading to two central questions: Is there a need for new implants to better simulate natural knee kinematics; and is there a need for different operative techniques in order to make classical implants work better in a higher proportion of individuals?

The initial concept of kinematic alignment means that we are resecting equal amounts of bone, medially and laterally, and the implant thickness restores exactly what we have resected so that the kinematically-aligned axis runs parallel to the posterior or distal condylar axis, and is way off from the surgical transepicondylar axis which is our orientation in classical neutral alignment.

«The difference between the kinematically-aligned and the transepicondylar axis is, on average, 4 degrees, but the interindividual variability is enormous, from +3 to -12 degrees (Knee. 2014;21:1120–3). Modifying neutral mechanical alignment may be the right way forward, but it still bears risks.»

If one uses symmetrical components designed for classical implantation, he went on, it will alter femoro-patellar tracking and create altered biomechanics. Short-term, this will be partially functioning and promising, but in the mid- to long-term the outcomes are unclear.

«On the other hand, if we are using asymmetric components, such a medial pivot implants or patient-matched implants which follow the same train of thought, the clinical and biomechanical mid- to long-term outcomes are also unclear.»

As such, he questioned whether improvement of patient satisfaction could be achieved by pursuing «non-mechanical alignment.» To explore further, he looked at the literature from the last few years, starting with Lucian Warth et al. (J Arthroplasty. 2017;32:2411–2416), who investigated correlation between intraoperative medial pivot and patient-reported outcome measures (PROM).

«They came to the conclusion that the understanding of how alignment and balance relates to kinematics and patient satisfaction remains in its infancy.»

The same group also looked at whether there was a correlation between dual pivot (early lateral/late medial kinematic pattern) and PROM (J Arthroplasty. 2017;32:3009–3015).

«They found that there is a tendency for more satisfaction in patients who did show dual pivot intraoperatively, but it is actually unclear how we can introduce that dual pivot intentionally.»

Clearly, lots of open questions remain within the medial pivot concept, continued Professor Niemeier. Nishitani et al. (Knee. 2018;25:1254–1261) evaluated medial pivot vs. symmetrical inserts, noting no difference in PROM. As they wrote, it remains unknown whether patient satisfaction can be improved with asymmetric medial pivot component designs or introduction of medial pivot with symmetrical designs.

In terms of mechanical alignment vs. kinematic alignment, several papers have emerged. A recent meta-analysis from Woon et al. (Arch Orthop Trauma Surg. 2018;138:1293–1303) showed that no differences in WOMAC (Western Ontario McMaster Universities Arthritis Index), KSS (Knee Society Score) or PROM scores could be seen between kinematic or mechanical alignment at one year postoperatively.

Niki et al. (J Arthroplasty. 2018;33:2125–2130) determined better function with kinematic alignment, while patient satisfaction was equal, and Blankeney et al. (Knee Surg Sports Traumatol Arthrosc. 2019;27:1410–1417) found a more normal gait pattern with kinematic alignment (PROM not recorded). Finally, Nakajima et al. (J Orthop Surg Res. 2018;13:320) revealed higher patient satisfaction in patients in whom the angle between the joint line and the line perpendicular to the mechanical axis (AJLMA) was more than 2 degrees in varus knees.

«That's interesting because this tells us that if there are individuals who have more than 3 degrees AJLMA, at least in varus knees, then this might be helpful.»

Turning to some concluding remarks, Professor Niemeier underlined that we have clearly just begun to understand the highly and individually variable nature of knee kinematics.

«Replication of the individual kinematics by a uniform technique or implant design is not yet possible.»

Additionally, the translation of emerging knowledge about kinematics into clinical practice in TKA at this point is subject to research, not routine usage.

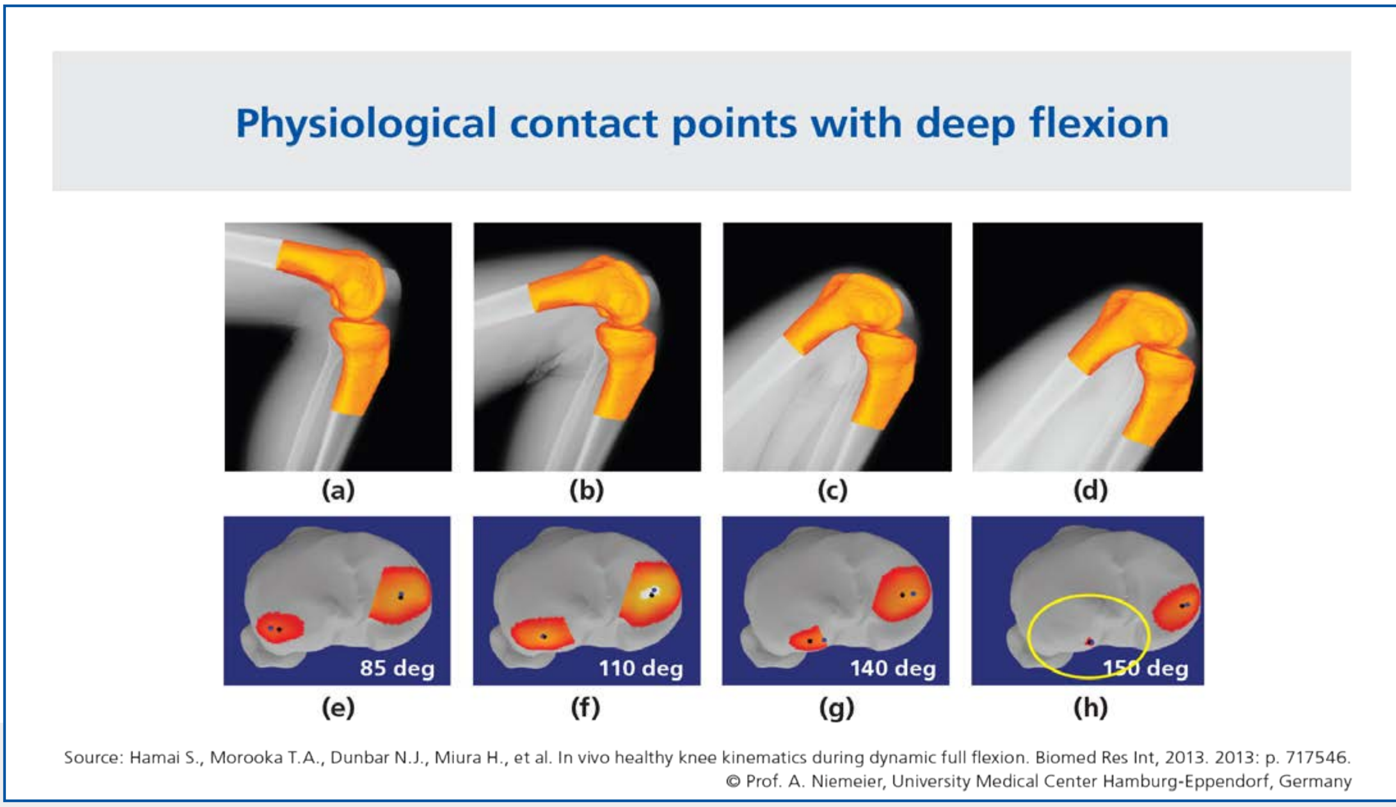


FIGURE 1.
Physiological contact points with varying degrees of flexion from 85 to 150 degrees.

«Until proven otherwise, it seems prudent to adhere to established principles of knee joint reconstruction with symmetric implant components in neutral mechanical alignment. The current challenge is to evaluate the new concepts with scientific rigour, and find out how we can respect the individual bone and soft tissue in mechanical alignment with symmetric implants in order to reduce the number of unsatisfied patients.»

INFLUENCE OF SOFT TISSUE BALANCING ON NATURAL KINEMATICS IN TKA

Stefan Eggli
Professor, MD – Bern, Switzerland

Every knee is different, thus an individual approach to each TKA is important to ensure the best soft tissue balancing and kinematic alignment, Professor Eggli underlined in the last presentation of the symposium.

«The primary goal of TKA is the restoration of axis and stability.»

he began, noting that in 95 % of cases, surgeons will remove the anterior and posterior cruciate ligaments and meniscus, and perform a perpendicular cut of the tibia and/or cut on the femoral side of 6 degrees, which creates a completely unstable situation (Figure 1).

However, he stressed that there is no intrinsic stability after these cuts, thus stability of the knee has to be regained with a prosthetic component. Indeed, even the cuts themselves can be classed as mistakes.

«The first cut is not natural; we cut perpendicular to the tibial axis.»

«This is kinematically a mistake, and we have to correct these mistakes to get the parallel flexion back. We have to cut too much away on the medial femoral condyle.»

That being said, for a symmetric implant this actually has in one good knock-on effect, he added: It rotates the component laterally and externally, so that the tracking of the patella is okay.

A bone-oriented technique, he went on, involves a cut, a release, proximalisation of the femur and the use of polyethylene for knee stability. However, this results in a constant joint line, along with distalisation of the patella and change to the rotational axis of the distal femur, which causes issues from a kinematic point of view.

And even with the advent of patient-specific instrumentation (PSI), robotic surgical tools and computer navigation, results have not improved.

«Nowadays we are trying to recreate the kinetic alignment using PSI or navigation systems; you get quite a lot of information about bony orientation and mechanics, but the missing information is the function of the ligaments, and the natural kinematics of the knee. Therefore, we still have the same problems as we had 10 to 20 years ago.»

Treating the individuality of the patient is therefore paramount, he went on, in order to respond to the huge variability in knee axes, ligaments and kinematics that has been reported (Figure 2; Clin Orthop Relat Res. 2012;470:45–53).

«The only thing we can actually measure before surgery is the bony anatomy.»

«We have no information about the ligaments or about the kinematics.»

Compared to a bone-oriented technique, kinematic alignment using a ligament-balancing technique has a number of benefits.

«The big advantage of a ligament-balancing technique is first you do a release, and then the bone cuts.»

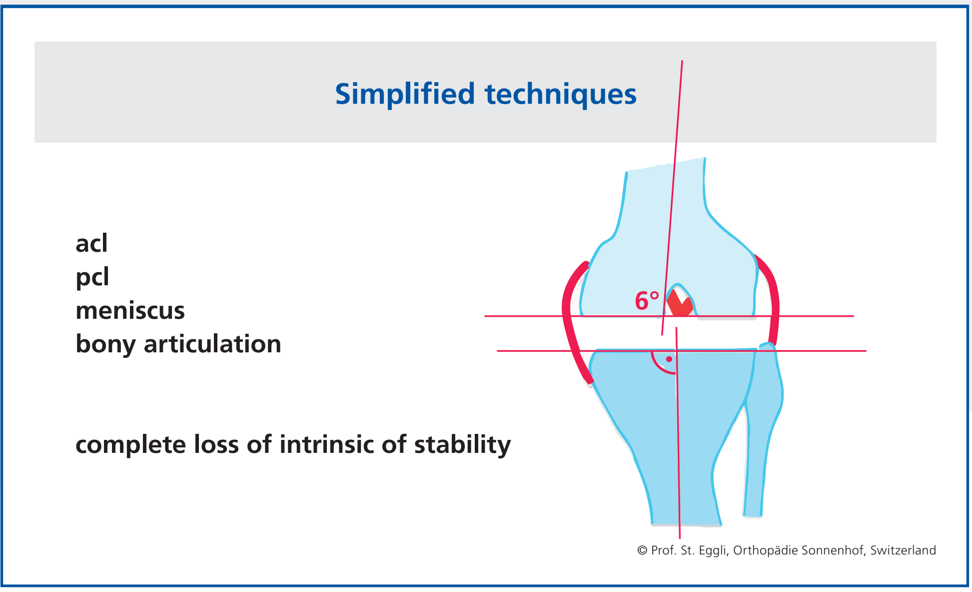


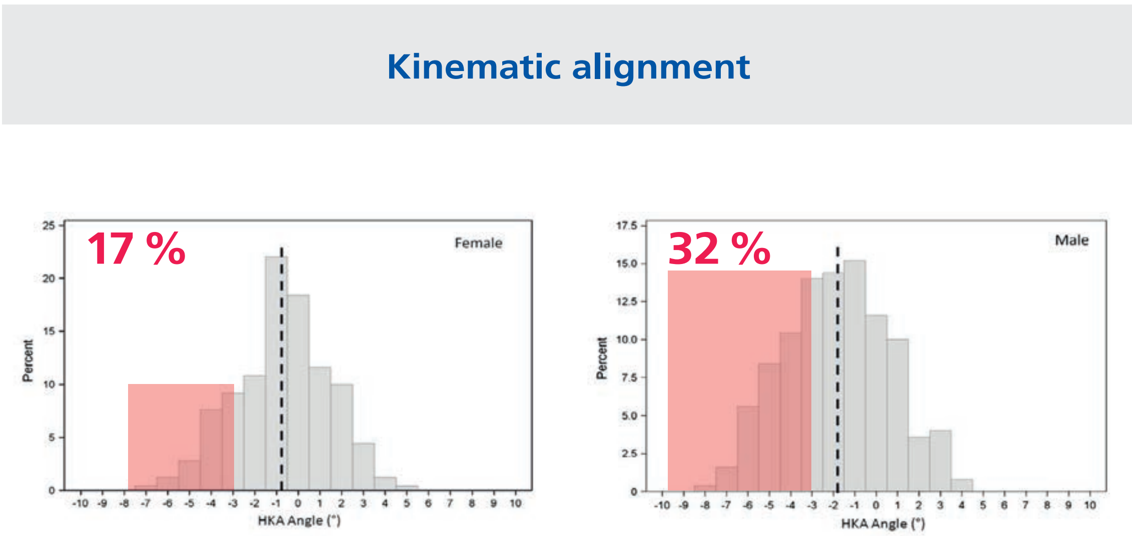
FIGURE 1.

«Then, the final orientation of the femoral components, joint line adjustment, sizing of component and restoration of the individual femoral rotational axis can still be done – completely different to when you do a mechanical alignment.»

A lot of evidence is emerging, he went on, showing that kinematic alignment in TKA reproduces a normal gait better than mechanical alignment can. For example, Blakeney el al. (Knee Surg Sports Traumatol Arthrosc. 2019;27:1410–1417) wrote that knee kinematics of patients with kinematically-aligned TKAs more closely resembled those of normal healthy controls than knee kinematics of patients with mechanically-aligned TKAs did.

Maderbacher et al. (Knee Surg Sports Traumatol Arthrosc. 2019;27:1427–1433) and Calliess et al. (Knee Surg Sports Traumatol Arthrosc. 2017;25:1743–1748) showed more natural and physiological tibiofemoral kinematic patterns for kinematically-aligned TKAs versus mechanically-aligned ones, while Dossett et al. (Bone Joint J. 2014;96-B:907–13) showed that the use of a kinematic alignment technique performed with patient-specific guides provided better pain relief and restored better function and range of movement than mechanical alignment performed with conventional instruments.

Offering his «basic principles» in summary, Professor Eggli reiterated that every knee is different, including



Adapted from: Bellemans J, Colyn W, Vandenneucker H, Victor J: The Chitranjan Ranawat Award- Is Neutral Mechanical Alignment Normal for All Patients? The Concept of Constitutional Varus. Clin Orthop Relat Res (2012) 470:45–53 © Prof. St. Eggli, Orthopädie Sonnenhof, Switzerland

FIGURE 2.

the axis, ligaments and kinematics parameters, thus an individual approach to TKA is paramount. Individuality is best considered with a ligament-balancing technique (Figure 3), he added – an easy method for kinematic alignment. But to perform it correctly, one needs asymmetric implants with modular trochlea, which corrects for rotation.

«Bone-oriented techniques adapt the knee to the 'anatomy' of the prosthesis, and ligament balancing is completely different, adapting the prosthesis to the anatomy of the knee. TKA is mainly a ligament surgery, not a bone surgery, and there is increasing evidence that kinematic alignment produces better clinical results.»

FIGURE 3.
Ligament tensioner for ligament-balancing technique.

BIOGRAPHIES

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Professor, MD – Hamburg, Germany

Andreas C Niemeier is Chair of the Department of Orthopaedics and Traumatology, Reinbek Hospital, and Professor of Orthopaedics at the University Medical Center Hamburg-Eppendorf, Germany. He is an academic orthopaedic surgeon with long-standing experience in primary and revision arthroplasty of the hip, knee, shoulder and elbow.

Professor Niemeier is a member of numerous national and international professional societies, reviews for numerous prestigious journals in the field, and is widely published. He enjoys teaching at all levels of experience, whether student, professional, or expert.

His research interests include basic and translational research in bone metabolism as well as the clinical outcomes of total joint replacement of the upper and lower limbs.

KARL STOFFEL

Professor, MD, PhD – Basel Switzerland

Karl Stoffel is Professor of Orthopaedic Surgery at the University of Basel and Deputy Head of Orthopaedics and Traumatology, Kantonsspital Baselland, Switzerland.

He is a member of a number of national and international societies, including the Royal Australian College of Surgeons (RACS), Australian Orthopaedic Association (AOA) and the Swiss Orthopaedic Association (FMH). As well as several book chapters, Professor Stoffel has authored or co-authored over 60 peer-reviewed publications, and has presented extensively at various congresses, delivering nearly 200 abstracts and invited lectures.

He spent a number of years working in orthopaedic surgery at the University of Western Australia, where he completed his PhD in Biomechanics and became a Fellow of the Australian College of Surgeons (FRACS). Professor Stoffel is still actively involved in research at institutes in Australia and Switzerland.

JOE BAINES

LMS, FRCSEd (T&O) – Glasgow, United Kingdom

Mr Baines qualified at the University of Navarre, Spain, before moving to the UK to complete his postgraduate training in orthopaedics in Glasgow, Bristol and Newcastle. He spent his fellowship in Cardiff, where he developed a special interest in hip arthroplasty and revision.

In 2007 he joined the Golden Jubilee National Hospital arthroplasty unit in Glasgow where he works as a full-time consultant in orthopaedics. There, he has devoted himself exclusively to hip and knee arthroplasty. His main interest is hip revision, and in particular, the management of infected hip replacements and complex defect reconstructions.

It was at the Golden Jubilee where he also developed an interest in computer-aided knee arthroplasty, of which he has become a leading figure, publishing, teaching and presenting extensively on the subject. Currently he is involved in clinical research related to Vitamin E highly cross-linked polyethylene, and innovation in the field of acetabular reconstruction and kinematic knee alignment.

DAMIAN MCCLELLAND

MD – Stoke-on-Trent, United Kingdom

Dr McClelland is a consultant trauma and orthopaedic surgeon at Royal Stoke University Hospital, in the United Kingdom, and an Honorary Senior Clinical Lecturer at Keele University. In addition, he leads Research in the Trauma and Orthopaedic Departments at the University Hospital of North Midlands, a major Trauma Centre. Since 2015 has served as the national Clinical Director for Bupa's Musculoskeletal Services in the UK.

Dr McClelland was Chief Investigator of the FASTER trial, a multicentre trial looking at ankle fracture management, and has also been the local principal investigator for the ProFHER, AIM and Wolff studies at his hospital. He is chairman of the AO Foundation's (Switzerland) UK and Ireland Principles courses. Has recently finished as chairman of the AOUK Shoulder and Elbow course and is due to chair the AO Advances Course in the UK starting next year. He has edited a number of orthopaedic papers and is actively involved in research at his institute.

STEFAN EGGLI

Professor, MD – Bern, Switzerland

Professor Eggli is Head of Knee Surgery and Sports Medicine and CEO of the Sonnenhof Orthopaedic Centre – a specialist centre continuing the work of the Bern School beyond both national and international borders.

A specialist in orthopaedic surgery and traumatology, he spends the majority of his time in complex sports injuries, novel cruciate ligament repair techniques and prosthetic knee revision surgery.

His research interests include novel prosthetic designs using resorbable metals and bioactive surface coatings, as well as autoreconstructive cruciate ligaments. Professor Eggli is currently President of the Bernese Society of Orthopedics, and serves on the Board of the Lindenhof Bern Foundation, a charitable and humanitarian initiative which has had a major influence on the healthcare climate in Bern for more than a century.

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