

# Implantation of Endoprosthesis

How digital preoperative planning software is used in orthopedics, trauma surgery and sports traumatology at the St. Elisabeth-Krankenhaus Dorsten hospital



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## The Interview

Interview with Priv.-Doz. Dr. med. Mike H. Baums

*The shoulder is the most mobile joint in the human body. This large range of movement is due in part to the low bony congruence, which means that a large humeral head rotates in a relatively small joint socket. Consequently, the shoulder joint relies mainly on the surrounding ligaments, tendons and muscles for its stability. This makes it particularly susceptible to injuries and degeneration. Treatment options are many, ranging from simply replacing the cartilage surface on the humeral head to performing a total endoprosthetic reconstruction to replace the joint socket surface as well. A timely, specialized and professional approach to treating injuries and preparing for operations is therefore all the more important.*

German hospitals are already implanting shoulder endoprostheses at a rate of up to 25 thousand per year, and this figure is steadily increasing. Physicians' and patients' demands for ideal preoperative planning using digital software are also on the rise, not just with regard to surgical preparations but also when it comes to the crucial aspects of saving costs and meeting documentation requirements. Priv.-Doz. Dr. med. Mike H. Baums, Chief Physician and head of Orthopedics, Trauma Surgery and Sports Traumatology at Katholisches Klinikum Ruhrgebiet Nord GmbH (KKRN) in the St. Elisabeth Krankenhaus Dorsten hospital, spoke with us about 2D and 3D digital preoperative planning in general, as well as about shoulder treatments and hip and knee endoprosthetics in particular.



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With 29 medical faculties in four locations, Katholisches Klinikum Ruhrgebiet Nord is the largest clinic association in Germany's northern Ruhr region. 2,630 highly qualified employees work here to improve the health and well-being of almost 38,860 patients each year.

The Orthopedics and Trauma Surgery faculties at the St. Elisabeth-Krankenhaus Dorsten hospital perform around eight to twelve orthopedic procedures per day on average. They include simple arthroscopic knee surgeries; primary shoulder, hip and knee endoprosthetics; treating limb fractures and periprosthetic fractures; endoprosthesis replacements; as well as foot and ankle surgery.

### **mediCAD Hectec GmbH:**

Planning, be it with or without digital assistance, is already required by law in areas like hip and knee endoprosthetics, but not yet for shoulder endoprosthetics.

Why hasn't this specification become established for the planning of shoulder joint surgeries?



Priv.-Doz. Dr. med. Mike H. Baums

### **Priv.-Doz. Dr. med. Mike H. Baums:**

We've been implanting hip and knee endoprostheses for a lot longer than we've been performing prosthetic surgeries on shoulder joints, so this multi-decade lead is one reason why things developed the way they did. Although shoulder joint endoprostheses have become much more common over the years, the latest implantation figures show that they are still outnumbered by knee and hip endoprostheses.

We've made a lot of progress in shoulder surgery in the meantime by developing innovations such as metaphyseally anchored implants and by implementing sophisticated inverse endoprostheses with inclination angles of 135° versus 155°, for example.

Here in Germany, the DVSE - that's the German Society of Shoulder and Elbow Surgery - has naturally evolved into a specialist body that, through its certification offerings, focuses on making more elaborate shoulder surgeries available to the wider public in the German-speaking region. But ultimately, it was also developments abroad that contributed to increasing the importance of shoulder surgery today. For example, despite its initial reluctance, the US has discovered inverse endoprosthetics as a potential tool. All this will increase the necessity for shoulder endoprosthetics, which will in turn require more planning and eventually the establishment of a legal framework - because we'll need transparency and ideal quality assurance in this field of endoprosthetics, too.

## Digital planning is the gold standard

### **mediCAD Hectec GmbH:**

Digital planning isn't a must, especially not for shoulder endoprosthetics, so why do you do it?

### **Priv.-Doz. Dr. med. Mike H. Baums:**

We must be clear about what we want to accomplish by implanting endoprostheses: Besides relieving pain, our main goal is to maximize functionality. We should also ensure that endoprostheses last for a long time while providing good load-bearing properties. These results naturally depend on the specific prerequisites. Shoulder and knee endoprostheses in particular must additionally account for the differing soft-tissue contractures and conditions in individual patients. This is where digital planning can supplement operating techniques, the surgeon's experience and the available materials as a powerful tool to meet these goals.

Digital planning developed in parallel with digital radiography, and it's therefore no longer necessary to print analog images. In addition to its convenience and the ease of saving data, one of the best arguments in favor of purchasing the software is surely the cost savings achieved by eliminating analog printouts. Digital radiographic imaging additionally reduces the radiation burden on patients.



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Highly precise digital planning pays off when doctors have to treat complex cases or correct posttraumatic malalignment. But this doesn't stop me from using it for all patients, not just for the tough cases. Even supposedly simple cases can present pitfalls, and digital planning lets us analyze each case individually.

Digital planning can help us predict results more reliably, even granted that orthopedic surgeons will occasionally encounter cases that are difficult to treat despite exact planning. Particularly the shoulder joint with its complex interplay between tendon musculature and the scapula's various movement axes can affect the biomechanics. Nevertheless, digital planning is crucial when reconstructing the lateral offset, avoiding "overstuffing" or reconstructing the knee's posterior offset. What's more, I think thorough digital planning can help to shorten operations.

Patients benefit from this, too – they don't lose as much blood, aren't as susceptible to infection and spend less time under anesthesia. Ultimately, sophisticated planning will enable surgeons to work more efficiently as well. We can't even conceive of doing without digital planning in our daily work. It increases transparency, improves our quality of care and, by storing documentation, has become indispensable when it comes to meeting legal requirements. Digital planning is easy to learn, and it doesn't take up too much of your time or effort to use. Digital planning is the gold standard in my opinion, because it provides certainty to surgeons and patients alike.

But even if you use planning software, it's ultimately the image quality that decisively affects any analysis of the joint geometry. Radiologists, radiology assistants, orthopedic and trauma surgeons need to work together in this regard.



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## High-quality planning improves results

**mediCAD Hectec GmbH:**

What prerequisites do you think are necessary to ensure that digital planning is established as a legally mandated component of shoulder endoprosthetics?

**Priv.-Doz. Dr. med. Mike H. Baums:**

Hard to say. I think it's a matter of cost. Binding specifications are already in place for procedures like hip and knee endoprosthetics, of course; but 2D or 3D planning ultimately means more work for the computer department to install and maintain the software. The resulting costs for a hospital or clinic aren't shown as part of the diagnosis-related groups or health insurance system, and thus have to be covered by another budget.

But it must be clear to all of us - lawmakers, funders, users, hospitals and practices alike - that high-quality planning ultimately contributes to better results. To me, improving results by reducing lengthy procedures or long follow-up treatments, shortening disability times, and possibly avoiding premature revision or replacement surgeries is a clear argument in favor of legally mandating planning for shoulder endoprosthetics.

**mediCAD Hectec GmbH:**

What do you consider to be the advantages of preoperative planning across all orthopedic disciplines - from the patients' viewpoint.

**Priv.-Doz. Dr. med. Mike H. Baums:**

Trust, a feeling of security, and a sense of understanding the procedures are the decisive aspects to me. We can do more than simply showing the procedure to patients on a model - we can provide them a detailed, step-by-step explanation of the operation based on their own X-ray images. This creates a sense of trust and transparency, as well as boosting patients' confidence in the surgical outcome, because digital planning demonstrates that the surgeon has dealt with the specifics of their individual cases. It also helps patients to understand the individual steps. The physician can explain how the leg length changes as the result of hip endoprosthetics, as well as how the leg axis is corrected in knee endoprosthetics, for example.

**mediCAD Hectec GmbH:**

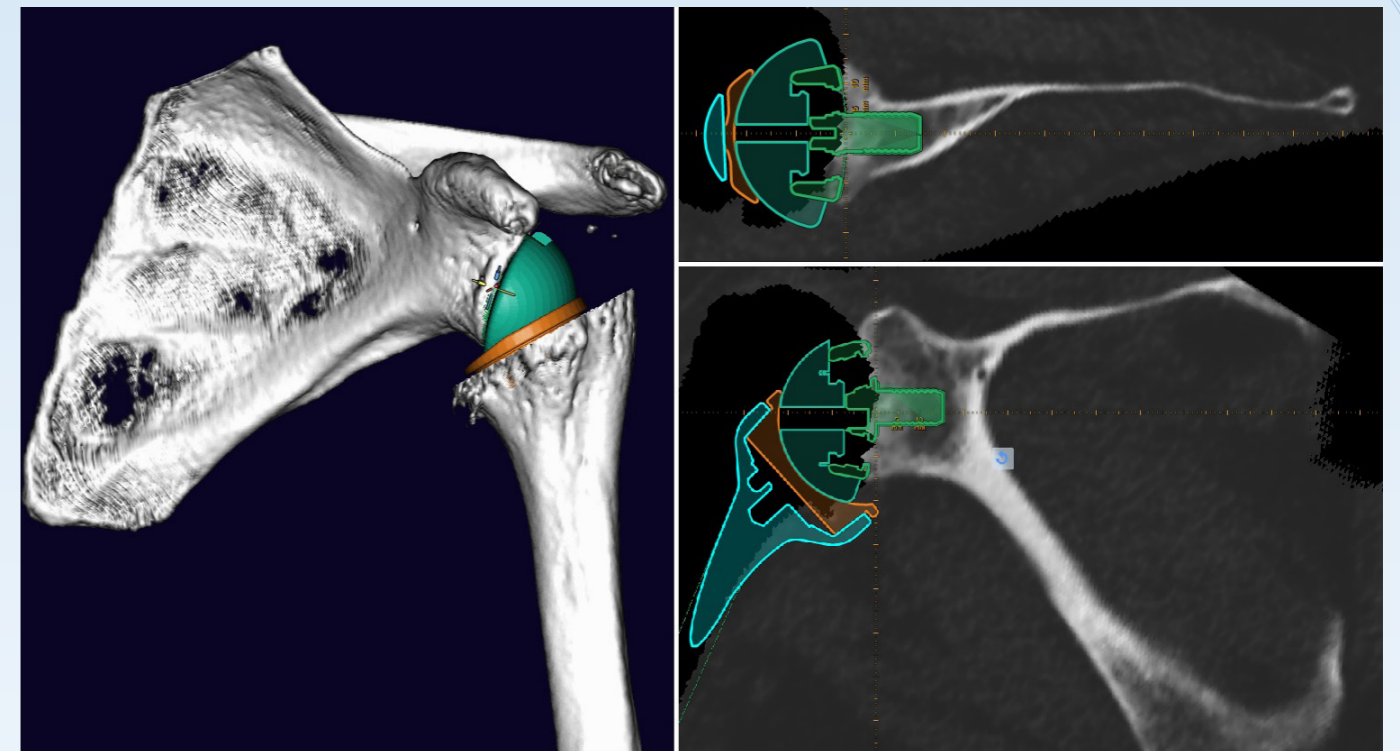
... and from the viewpoint of doctors and clinics?

**Priv.-Doz. Dr. med. Mike H. Baums:**

Like I said before, the time aspect and the resulting costs play a key role, as does the aspect of certainty for surgeons. And let's not forget the welcome advantage of being able to analyze complex cases in detail. But planning shouldn't be restricted to complex or difficult cases - I consider it mandatory for all cases. To me, it's the gold standard of preoperative preparation. 2D planning produces highly reliable planning results, can be learned easily and quickly, and provides secure documentation while ensuring legal certainty.

But it still must be said that any analysis of the joint geometry depends on the quality of the radiographs taken. After all, digital planning is now the state of the art and should be the gold standard, too.

To me as a surgeon, the success of a joint replacement operation hinges on bringing a well-developed plan into the operating room. Digital planning lets me work this out in advance. Initial experience with 3D planning not only proves this, but demonstrates further improvements in the preparation of a preoperative plan as well.



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**mediCAD Hectec GmbH:**

Do you produce plans exclusively to prepare for operations or to discuss with your colleagues in house, or do you also actively employ them when speaking with patients before and after surgeries?

**Priv.-Doz. Dr. med. Mike H. Baums:**

Yes, I also use the plans when I'm speaking with patients about their surgeries. But I use an endoprosthesis model, too. Combining both tools gives me, the surgeon, options for improving and simplifying the aspects I mentioned. I use the preoperative plan for postoperative discussions about the case as well. This lets me demonstrate that the surgery went according to plan. Internally, the planning software additionally serves the purpose of postoperative analysis of the result quality, as EndoCert demands for hip and knee surgeries. It can be used to answer questions like: Was the surgery implemented exactly as planned? Was the planned result achieved? Did any problems occur that might be relevant for future plans?

## Planning is a vital tool

### **mediCAD Hectec GmbH:**

You use mediCAD Hectec GmbH products for planning hip, knee and shoulder surgeries. Who uses mediCAD® in your clinic? Who prepares the planning? Is it just you, or are other colleagues or assistant physicians involved as well?

### **Priv.-Doz. Dr. med. Mike H. Baums:**

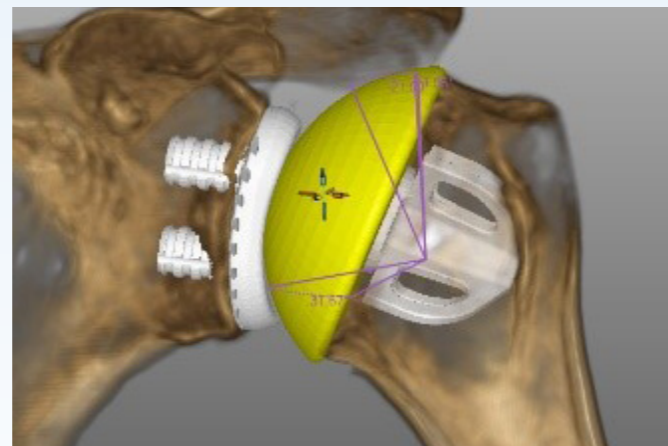
Our department was pretty much newly established. That's why I produced and demonstrated all the plans myself at first. Then, after a team of senior physicians was set up, the senior physicians and all other surgeons took on these tasks as well. I considered this to be an important approach in the early stages to achieve a uniform quality level. We're currently establishing the planning processes among the assistant physicians as well, because I consider preoperative planning to be a vital tool in specialist medical training. Some inexperienced assistant physicians initially labor under the impression that all they need to do is swap out a joint for a piece of metal, and they're done. But it's not immediately clear to everybody that, when a hip endoprosthetic procedure is being performed, for example, the offset needs to be reconstructed to ensure adequate muscle tone and improve the patient's activity level. The planning software illustrates this very well, which makes it a great teaching tool as well. If you combine this with various available shaft models, such as short shafts and straight shafts, you can additionally illustrate these aspects in detail prior to surgeries and thereby determine the most suitable implant and procedure for reconstructing the specific anatomy. That's what I call sophisticated endoprosthetics.

### **mediCAD Hectec GmbH:**

You use mediCAD® 2D for your hip and knee planning but rely on the new mediCAD® 3D Shoulder module for shoulder surgeries. Why did you choose the 3D module for shoulder operations? Wouldn't 2D have been sufficient? What are your favorite advantages and functions?

### **Priv.-Doz. Dr. med. Mike H. Baums:**

Basically, 2D planning already is a reproducible planning tool available to us for interoperative feedback. 3D planning naturally offers the advantage of letting you look at the endoprosthesis from virtually all sides and all angles. It can provide an all-round view of osteophytes, and shows what happens when they're removed or left in place, which can often lead to surprising insights.

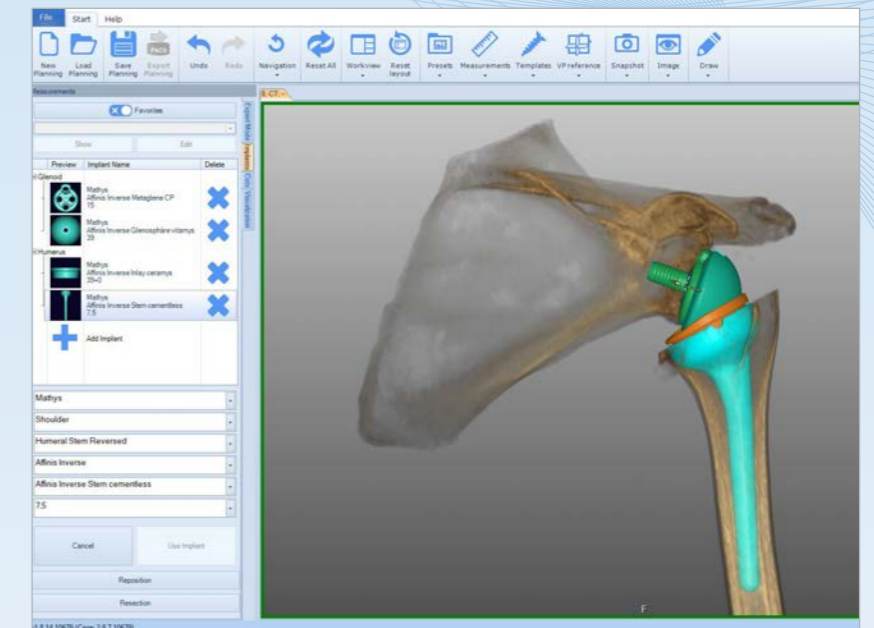


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An improved depiction of head and osteophyte resection is possible, and preoperative analysis can improve implementation of interoperative glenoid component positioning.

Functions like preoperative ROM analysis also seem useful to me, not to mention the additional knowledge I get when the scapular plane and humeral axes are taken into account. This is a practical expansion, and the prerequisite for achieving a functionally good surgery result.

3D planning is also new to us, though; and we're still in the process of establishing it at our clinic. I don't find the learning curve to be as steep as that for 2D planning, but it does take a lot longer at first to get oriented and discover all the finer points of planning. Therefore, planning can sometimes still take up to an hour. But don't forget that more thorough planning can certainly shorten operating times.



### **mediCAD Hectec GmbH:**

From the patients' viewpoint: Will patients or their insurers face higher costs when 3D planning is used, given that it requires CT/MRI images? Will health insurers cover these costs?

### **Priv.-Doz. Dr. med. Mike H. Baums:**

I completely agree with the associations' demands in this regard. To treat a joint as complex as the shoulder, we need more information to supplement the corresponding radiograph series of a.p., axial and outlet views: What's the status of the rotator cuff and its musculature? We also need to know what glenoid type we're dealing with, what other injuries are present, where osteophytes are located and how pronounced they are, whether the humeral head is or isn't centered in the joint, and whether bony defects are present that could affect things like the glenoid's angle or retroversion. Is the center of rotation medialized? Not only must we know all of these aspects before performing surgeries; we must include them in our preoperative planning as well. I thus consider MRI and CT to be absolute necessities for the preoperative planning of endoprostheses. This means patients won't have to pay extra for them. On the other hand, clinics will naturally incur extra costs to purchase the software and any necessary high-performance PCs. It will also be necessary to work with a radiologist to develop a CT protocol. Many patients bring along externally produced CTs, but these often don't meet the requirements for creating a 3D plan. Here, our approach will depend on cooperating with the radiologists, most of whom work in private practice, and considering the equipment at their disposal.

The problem faced by clinics or surgical offices surely lies in the fact that the health insurance system does not cover the purchasing costs for the software or the cost of the physician's time required for planning. I think it makes sense to solve this problem with constructive legislation in future.

## Switching to 3D planning

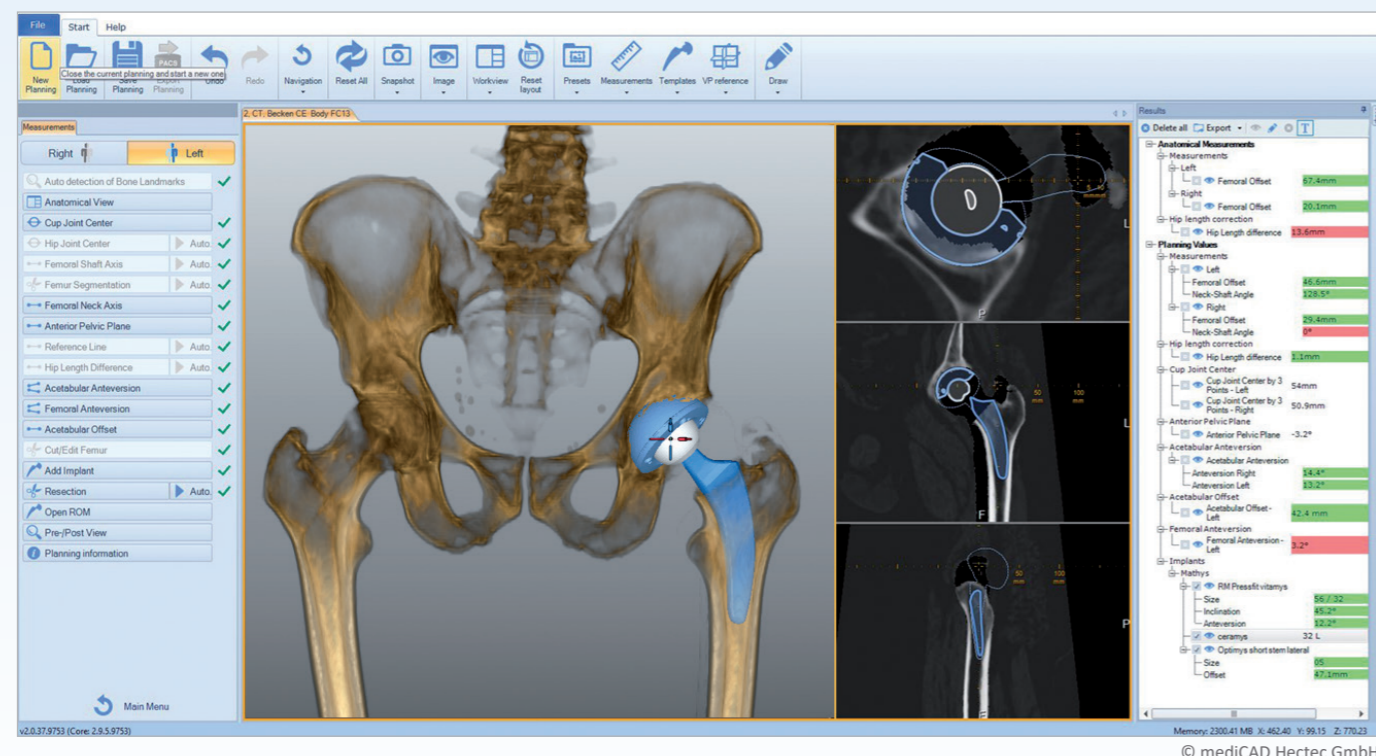
### mediCAD Hectec GmbH:

Now, about hip and knee planning - why do you stick to using just 2D here, even though manufacturers like mediCAD® are already offering 3D planning modules?

### Priv.-Doz. Dr. med. Mike H. Baums:

I don't think manufacturers offering such a product is the problem. There could naturally be one or two teething problems that need to be solved to improve basic 3D planning. I think one of the key problems lies in generating the required data using a suitable CT data protocol. When patients bring their own CT scans with them, the generated data sets usually do not meet the prerequisites for successful, evident 3D planning. These outliers will probably always exist, and I think the risk of excessive radiation exposure would make it ethically unjustifiable to generate another CT soon afterward.

Within our clinic, we must first work with our radiology department to develop the organizational prerequisites for establishing 3D planning. This also applies to the CT protocol, for example. I've been here for less than four years, and our radiologist for less than two, so we initially had more pressing things to establish than 3D planning. Until recently, for example, physicians had been performing endoprosthetic surgeries at our clinic without previous planning of any kind. This is unjustifiable. That's why we had to establish 2D planning first; we'll see about everything else.



### mediCAD Hectec GmbH:

Can you picture yourself switching to 3D in the medium term, and what do you think about the prospects for 3D on the market?

### Priv.-Doz. Dr. med. Mike H. Baums:

Studies on this topic have been sporadic so far, but their findings generally look promising. 3D seems to allow better size and rotational alignment of knee prostheses than can be achieved with 2D planning. Except for a limitation regarding sagittal size alignment, a current, systematic review in the literature also confirms the suitability of producing 3D CTs given adequate planning.

It's the costs for generating the data that'll be the problem here because, like I said before, neither the health insurance system nor the diagnosis-related groups show them. Widespread introduction of 3D planning will depend on future considerations like this, and that's why it'll probably be confined to large clinics or clinic associations at first.

I think 3D planning can be a very helpful tool for revision or replacement surgeries and in difficult situations like posttraumatic conditions and cases of pronounced hip dysplasia. However, especially when 3D planning is used for revision endoprostheses, it's the quality of available CT images that will determine the use for inset implants. Implementing this in the organization will require working with internal and external radiologists, as well as radiology assistants.

It's hard to say whether or how 3D planning will succeed on the large scale, because this brings us back to the cost problem I mentioned earlier. We'll need to discuss feasible approaches with lawmakers, funders and hospital owners to establish the prerequisites for introducing this vital tool for patient safety. Neither the navigation functions nor the PSI proved to be much of an improvement in some studies. But I still consider 3D planning to be the right approach. Having said this, I want to point out that 3D planning will never be the solution to all problems. Particularly in knee endoprosthetics, the result depends on soft tissue and ligament balancing and thus to a large degree on the surgeon's expertise. However, I do think 3D planning can be a useful tool to help experienced surgeons obtain optimal results.

### mediCAD Hectec GmbH:

Dr. Baums, thank you very much for your support.



**mediCAD Hectec GmbH**

Opalstr. 54  
DE-84032 Altdorf  
Germany

Tel. +49 871 330 203-0  
E-Mail: [info@mediCAD.eu](mailto:info@mediCAD.eu)