

Editorial

From Around The World™...Over 55 Years of Treatment of Periprosthetic Joint Infections"

Thorsten Gehrke, MD^a

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The author reviews the experience of the German Endoclinic, which began in 1969.

I'm going to talk a little bit about the experience in the treatment of periprosthetic joint infections in the German Endoclinic during the last, let's say, 55 years.

It started in 1969 when the founder, the late founder of the Endoclinic, Buchholz was his name, came up with the idea to add antibiotics to the bone cement. He was the first one who had the idea to add antibiotics to the bone cement. The goal was that the antibiotics were eluting out of the bone cement and protecting the new device from colonization. This was in 1969, and this was also the birthplace for the one-stage exchange procedure in the case of a PJI. He created the chance to change infected joints in one session because he used this antibiotic bone cement to protect the newly implanted device. Of course, the whole procedure includes debridement, removal of the implants, and the antibiotic in the bone cement. He published his first data around 1972 on the one-stage exchange. He was the only one worldwide who did this because of the two-stage exchange, removal of the implant, implant-free interval, and then re-implantation was the gold standard worldwide and still is the gold standard worldwide. So, this method of the Endoclinic was an exception.

He came up with some quite good data and published it at the end of the 70s and beginning of the 80s, with a quite good success rate of about 80-85%. But still, in the 80s and the 90s, the one-stage exchange procedure was almost only reserved for the Endoclinic. The rest of the world did something else, two stages, three stages, something else. Interestingly, over the last 25 years, the interest in PJI increased dramatically because it is still the biggest challenge in total joint arthroplasty. It is the biggest challenge for everybody, for the surgeon, for the infectologist, for the microbiologist, and at least for the patients, of course.

As I became more and more interested in the field, I started to travel and talk about one-stage exchange 30

years ago. Everybody was interested but nobody followed our concept because you need a very special logistic to do this. You need a specialized team, you need a specialized environment, and you need specialized recommendations or advice of interested microbiologist or infectious disease specialist.

Then 25 years, it started to become more and more interesting all over the world. In some groups, in Sao Paulo, in Norway, even here in the US started with a one-stage procedure. Then, due to the problem regarding the diagnosis, treatment, prevention of periprosthetic joint infection, there are many papers in the literature about it, but there is absolutely no evidence about it. Due to this fact, Jay Parvisi and I came to the idea in 2012 to build up a consensus meeting. The goal was, if you have no evidence in the field, at least you should reach some consensus based on the available literature. We organized the meeting in 2013, and it was a meeting, I think, about 80 or 90 countries were involved. It was according to the Delphi method, and what we have done, we invited about 500 or 600 experts from all over the world. We created questions, unanswered questions, where we would get some consensus. That was the first consensus meeting. Five years later, we organized the second consensus meeting in Philadelphia as well. At Jefferson. There we had about 110 countries involved and about 1000 experts. Because there are still a lot of open questions, we are planning to organize the next consensus meeting next year in 2025 in Istanbul. There we have already 130 countries and 1500 experts who are coming together and discussing open question to really get consensus.

These consensus meetings were quite successful, they became guidelines status. We didn't want to build up guidelines because guidelines in most countries have forensic consequence. So, if you don't follow them, that's just a rec-

^a Thorsten Gehrke, MD, holds the position of Medical Director and Chief Physician at the ENDO-Klinik Hamburg, Germany. This hospital does about about 8,000 Joint Replacements per Year, and is the biggest specialized hospital in Europe. He is one of the leading experts in the field of Periprosthetic Joint Infections. Additionally, he obtained a worldwide reputation by organizing and chairing together with Dr. Javad Parvizi the International Consensus Conference on Periprosthetic Joint Infections (PJI) in Philadelphia in 2013, 2018 and 2025.

[Conflicts of Interest Statement for Dr. Thorsten Gehrke](#)

ommendation. But it became something like guidelines in most of the countries in the world, in Latin America, in Asia. That's it.

During the same time, when the interest increased in periprosthetic joint infection, there was a development that more and more surgeons became interested in one-stage exchange procedures. Slowly, here in the US, more and more surgeons are doing it now.

Here in the US, I started, I think, three, four years ago, a prospective randomized trial. One-stage versus two-stage exchange under the lead of Tom Fehring from Northern Carolina. It's a multi-center study where they showed in this prospective randomized trial that the one stage gives even better results even here in the US, even here where the surgeons are not so experienced in the one-stage procedure, gave better results than the two stages. In UK, they did the same independently, another randomized prospective trial and they came to the same conclusion. There's no superiority of the two-stage exchange procedure. It's the same or even better in the short run and regarding complication rate.

Why am I telling you this? It's because it's a new development which gives massive benefits for the patients. They need just one surgery instead of the first surgery, waiting two or three months without the joint and re-implantation after two or three months. So, it's a big progress in the treatment of periprosthetic joint infection.

There are still many other areas which are not clear at the moment regarding PJIs, especially diagnostics. The definition of PJI is extremely complicated due to many facts, due to the difficulty to identify the germs, the culture, or we see more and more culture-negative results where you cannot find the bug that is causing the infection. The whole process is not really clear. That's another issue because societies in many countries each have their own definition of periprosthetic joint infection. That's our next goal. We are working on a world-unified, definition for periprosthetic joint infections, together with the biggest European and American groups, MSIS, EBGIS in Europe, ICM, and some others here in the US, to get a consensus or to get one definition which is really working worldwide.

This is a big step forward. We established definitions already in 2018 for the consensus meeting but it was not accepted worldwide by MSIS or by the Europeans. Every society wanted its own definition.

That's the story about this experience, development from one stage, the origin was the antibiotic-loaded bone cement. I always had a hard time in the 90s when I started to talk about one-stage exchange because it was not accepted at all, nobody believed us.

But in the meantime, it is really quite well accepted due to the results of Tom Fehring's group. Of course, there is a lot of criticism, as always about this trial, but the results are very clear. There is a switch at the moment from two-stage to one-stage in the US or worldwide. The problem is, and this is the biggest problem, the good results are mainly coming from specialized centers, from referral centers. That's the biggest problem, in my opinion, because it

is not easy just to copy the algorithm and logistics of a one-stage exchange.

You need really dedicated staff to do this, starting from the surgeon, nurses, and physiotherapists. It is a multidisciplinary approach to solve the problem. You need a multidisciplinary approach. I think that's very important and one of the most important take-home messages is that this surgery should be done by specialized surgeons in specialized centers. In Europe, they have some dedicated specialized centers. Here in US, it's just starting. Tom Fehring's group is probably the only one of the specialized infection centers. Now, I know some guy between us, Peter Schrag is now trying to bring it over to US, like the ASCs and that's a big step. I will advise them, and I'm on the board and we will spread it over the whole US. In all the metropolitan areas there should be at least one dedicated, specialized center where the surgeons can send the infections.

The next issue, the biggest issue here, is reimbursement. It's a big surgery. It's an extremely expensive surgery because you need mainly revision implants, which are really expensive. You need antibiotics, which are sometimes also extremely expensive. For example, if you have a fungal infection, you need antifungal drugs. It's called Amphotericin B. The most effective Amphotericin B is the Amphotericin B as a liposomal. The treatment of one patient costs about \$10,000, just the antifungals. The reimbursement, I don't know how it is here in the US, how much, but in Germany, the reimbursement for the whole procedure for one stage is about €12,000 to €13,000. You can imagine if you pay just for the medicine \$10,000, then you have additionally to pay for hospital costs and the staff and the implants. It's not really a good business. This must be changed. These dedicated centers must be reimbursed.

Another point is the surgeon, of course. I don't know how the numbers are here in the US, but in Germany, even in a university hospital, surgeons are doing about 5–8 PJI treatments. In our institution, we do 500 PJI's a year. My team has about five senior surgeons who are allowed, who are really dedicated surgeons and they are the only surgeons who are allowed to perform this kind of surgery. They do about 100. Almost 20-fold of an average surgeon, and you have to be specialized, otherwise, your surgical technique is not adequate.

It's really like tumor surgery. Like in tumor surgery, in this infection or septic surgery, it is extremely difficult to find the border or the interface between healthy and infected tissue, like tumor tissue or healthy tissue. It's very comparable. For this, you need very well-trained surgeons. That's another prerequisite for such a center. Only in those centers you can you really train surgeons in that way.

It's not an emergency procedure. Most of the infections, 95% are low-grade infections. There is no need to rush. You can prepare the patient optimally because these are really low-grade infections. Patient's pain, it's a local infection in the joint.

Of course, there's always a danger of becoming septic, but that's very rare. You have the time to send them to a center, even if it is hundreds of miles away.

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