An Interview with the Medical Technology Expert Professor Marc Kraft

More Potential Savings Please!

Three major trends will determine the future of medical technology – one of them is cost-savings

Professor Kraft, 20 years ago a gall bladder was removed by way of an incision approximately 20cm long; nowadays this operation is carried out using minimally invasive surgery and the incisions made are only around half a centimetre in length. It is safe to say that technology has revolutionized this area of medicine. What can we expect in the next 20 years?

Prof. Kraft: I think that there are three main factors that will determine the future directions of developments in medical technology. In no particular order of importance, I would identify the following developments. The first line of development is focused on the economic aspect; in other words, new technologies will be developed to generate potential savings in the healthcare system. This also includes the development of multi-use technologies for medical devices. Secondly, the 'miniaturisation" of surgery that you mentioned looks set to continue, since, on the one hand, new minimally-invasive technologies will be further developed and, on the other hand, imaging procedures will replace many invasive diagnostic techniques. The third direction relates to the development of replacement human organs and body parts.

Let us begin with the economic aspect. How can technical innovations help to reduce costs?

Prof. Kraft: The economic constraints in the healthcare system have a significant effect on the development of new medical devices. An increasingly important criterion for the introduction of new technology is the need for economic efficiency. This can mean savings in terms of consumables, but in particular, savings through better and faster therapeutic success rates, reducing hospital stays or the number of days on which nursing care is required. If a new technology can lead to direct savings in a hospital, then that is, understandably, a strong argument in favour of the introduction of that technology.

Could you give an example?

Prof. Kraft: In collaboration with the Industry Association Spectaris we examined the "potential for savings through innovative medical technology in the healthcare system" and published the results in a study by the same name. One example included in this study is an orthotic device to relieve the heel, which halved the recovery time following a heel bone fracture, thereby enabling patients to return to work sooner. A further example is the new systems in anaesthetics, which enable the duration of intensive care nursing to be reduced. This represents an immense potential saving, since intensive care is much more expensive than other wards. In the future, companies will tailor their product development less toward what is technically or medically possible and will instead concentrate more on the economic aspect. In the next few years we will also see much cheaper equipment entering the market, offering a multitude of different uses, as is often the case already today. Here, we will see a concentration on those functions that are absolutely necessary. More complex technologies will also be implemented in other groups of equipment, for example, for research purposes or in clinical trials.

The issue of the demand for care in an ageing society arises in connection with economic restrictions. Can medical technology combine these two elements?

Prof. Kraft: Of course, in addition to increasing demand, there are also ethical implications, specifically what society can afford. This, in turn, dictates the demands made on medical technology to provide technologies for a large number of patients at the lowest possible cost. Let me give you an example: in the Automation Technology Department at the Technische Universität Berlin we have a research project concerned with neurological rehabilitation following a stroke. Since the rehabilitation of a patient who has suffered a stroke is usually very staff-intensive (especially for patients with paralysis of the extremities, who require up to three carers), a ‘haptic walker’ that does what the carers would otherwise do was developed. The haptic walker holds and moves the patient so that he/she can learn to walk again. In a combined clinical trial with the Charité hospital in Berlin, the success of these new technologies is now being verified against two criteria. First, the rate of medical rehabilitation success must be at least as good as or better than conventional therapy. Secondly there is the economic aspect. Due to demographic change, the number of stroke patients is also likely to increase and soon it will no longer be possible to operate rehab clinics with as many staff as has been the case to date. As a result, we are forced in various places to replace staff-intensive rehab phases with technical procedures, which then also provide better results. This is the potential we want to tap into.

Let us come now to “miniaturisation”. Will this continue to be one of the major directions in medical technology?

Prof. Kraft: One major direction of development is without a doubt in the area of computer-aided operating procedures, also in the context of miniaturisation. This is ultimately to be seen as part of the movement to reduce patient trauma in surgery. In the future we will see more and more procedures in which the surgeon accesses interior cavities via small shafts in order then to operate inside the body. Here, the trend witnessed over the last 10 to 15 years is set to continue and new minimally invasive procedures will increasingly replace open surgery. In addition, there will be a move away from invasive diagnostic techniques as we know them, for example in the area of catheter technology, which is used to show contrast agents in arteries. Examinations of this kind, which subject the patient to a certain degree of trauma at the incision point, will not be necessary in the future. They will be replaced with imaging procedures such as magnetic resonance tomography (MRT), which can provide whole 3D models without exposing the patient to radiation, and, with the use of a variety of filters, can also show images of various individual organs. Overall, the invasiveness of procedures will decrease significantly.

Where the development of replacement human organs and body parts is concerned, it is less the economic factor and more the limits of what is medically/technically feasible that continue to be the driving force. What is happening in this area?

Prof. Kraft: In the future we are sure to see increasingly higher quality replacements for organs and body parts e.g. following amputations. One area of emphasis will also be the development of artificial organs, including kidneys and perhaps even liver and pancreas replacements. In the field of implants, tissue engineering is very important. Here, we are seeing endeavours to develop “replacement parts” through the external cultivation of body tissue, such as, for example, heart valves, by colonising supporting tissue with body cells and trying to create a biological replacement for the existing body parts.

Doesn’t that take us into the field of biotechnology?

Prof. Kraft: Another future trend is that there will be ever-closer connections with other areas, in particular with the medicinal products area and with biotechnology. If, for example, it becomes possible to implant prosthetic biological heart valves with own body tissue such that they will function reliably, then it will no longer be necessary to further develop mechanical heart valves. To this extent, medical technology gives way somewhat to biotechnology. The same is true of insulin therapy or dialysis. If it were possible to replace kidney function using tissue engineering or to make the kidneys function again, at least in part, dialysis would also become redundant. This development is, of course, in the patient’s interests, but it is also linked with the fact that medical technology will no longer be required in these areas. I think, however, that medical technology will still have enough exciting tasks.

On of the exciting tasks facing medical technology is surely the development of exo-prosthetics?

Prof. Kraft: Yes, medical technology will certainly take on increasingly complex functions in the area of exo-prosthetics for amputees. Today there are already computer-controlled systems that relieve the patient by taking over monitoring functions. In highly functional prosthetics of this kind, the system itself records the current type of use and walking speed, and adjusts the dampening accordingly. A major challenge will be the connection of such prosthetics to the natural nervous system of the patient, in the first instance to operate control functions. Today, surface electrodes are placed on the muscles of the stump and the patient

has to learn to move the corresponding muscle, i.e. existing muscle groups are used. If one were actually able to connect nerves to the system, it would be possible once again to use the neurons that were once responsible for the lost limb to control the artificial limbs.
This is important, in particular where more complex prosthetic components are to be used for the control of individual fingers. There have already been some attempts but these have not yet been successful enough to be implemented. These initial attempts will be developed significantly in the next 20 years.

How does the Medical Technology Department at the TU, which you run, place itself in terms of these three areas of development?

Prof. Kraft: We have positioned ourselves in all three directions with relevant projects in each field. The subject of "economising" encompasses, in particular, the development of processing technologies for more complex medical devices, as in the collaborative study with Spectaris mentioned above. In the field of miniaturisation we are currently working with Olympus on a new project for minimally invasive surgery, which concerns the development of a sewing device, which makes it possible to sew inside the body. Our objective is to automate sewing technology such that knots can also be tied inside the body. In the context of the further development of replacement body parts we are heading a project examining physical strain on amputees. In addition, our research team is preparing evaluation criteria for aids such as orthotics and applications for the treatment of decubitus ulcers and, as a result, is involved in the definition of quality standards.

Marc Kraft was interviewed by Beatrice Hamberger

Prof. Dr. Ing. Marc Kraft has a degree in engineering and since 2004 has managed the medical technology department at the Technische Universität Berlin in his capacity as Professor.