Osteoarthritis (OA) is one of the leading causes of pain and disability in the Western World [1]. Over the last 40 years, total hip replacement (THR) has become a successful and widely acclaimed procedure to treat hip arthritis and to restore functional status and quality of life [2]. Due to extensive orthopedic research in improvements of prosthetic materials and design, fixation techniques, implant–tissue interaction and process-optimizing, THR became a highly effective technology with durable long-term results, while being very cost-effective [3].

A variety of surgical approaches are in use for the performance of THR, including anterior, anterolateral, direct lateral, transtrochanteric, and posterior techniques [4–11]. These approaches are typically performed through incisions from 20–30 cm in length and an optimal exposure of acetabulum and proximal femur is guaranteed. Due to excellent results and very low complication rates, these approaches were not yet in need for improvement.

Minimal invasive surgical techniques have been developed and used in orthopedic surgery for cruciate ligament repairs, unicondylar knee replacements and surgical fixation of fractures. Recently, minimally invasive techniques for THA (skin incision <10 cm) have sparked an increased interest among orthopedic surgeons. The modifications include a single abbreviated incision for anterior or posterior approach and a two-incision technique for anterior approach via the femoral neck for cup placement and a posterior approach in the line of the femoral canal for femoral component insertion [12–19]. The premise is to reduce the trauma of surgery while maintaining the perceived high levels of safety, efficacy, and durability of the procedure.

Early results suggest quicker recovery, faster rehabilitation, improved function, better cosmetic appearance, higher patient satisfaction, and better resource utilization by reduced length of hospital stay and lowered costs; however, the patient groups in observation are still small [13–17, 20–22]. On the other hand, there are major concerns about new potential risks due to reduced visualization, resulting in implant malposition, and poor fixation, resulting in compromised long-term results. The potential benefits of a smaller incision need to be balanced against the added operative difficulty, possible new risks, and drawbacks of a new learning curve, associated with minimally invasive procedures.

To become adopted as a standard procedure, the new technique must pass the test of clinical safety, efficacy and durability. A definite answer can only arise from long-term studies. However, today there are no long-term data which compare the durability of hip arthroplasty performed through a minimally invasive approach with conventional THR.

Major variations in the THR rates per head of population can be observed between European countries, as well as variations in the peri-operative regimes used and costs incurred [23]. Evidence-based consensus on the indication for surgical treatment, the most appropriate surgical procedures, optimal peri-operative care regimes and rehabilitation protocols are lacking. This leads to huge variations and potential inequalities in care. Main reasons for this inhomogeneity are differences in the health-care systems, the reimbursement systems and the philosophy behind treatment protocols. Most European countries have a public health system allowing everybody, irrespective of his financial background, to receive a total hip replacement. However, in most countries, the
majority of patients has no option to choose between surgeons, operative techniques or implants. Only privately insured patients might have the opportunity to select their surgeon.

In the recent past, in most Western Europe nations the THR treatment process was dominated on the one hand by public health guidelines regulating time of surgery, numbers of procedures per clinic and year, length of hospital stay, and on the other hand by reimbursement unrelated to the implants used and to the fixation technique applied. Therefore, progressive reductions of length of stay or specializations in new but potentially expensive techniques in the learning period, was not favorable for the hospital budget [24]. Only recently some countries have introduced DRGs (Diagnosis Related Groups), resulting in payment per procedure and stimulating early discharge from the hospital. However, a quality-related payment or reimbursement for the products used are still not in place.

A comprehensive description of a European treatment and rehabilitation concept is impossible. Different health-care structures and reimbursement systems but also different philosophies, national traditions, cultural differences and marketing activities of the industry have a strong influence on the practice pattern. A descriptive analysis of the THRs implanted is only available in the Scandinavian national registers, some regional THR registers in the UK and some further central European countries [3,25-28]. There is a huge variety of implant systems available on the market. While in some countries about 80% of all operations are performed using 1 to 5 types of prostheses [29], it is assumed that 120-170 different types of total hip replacements are in use in some of the other countries [30].

In the first three decades of THR operations mechanical loosening and extensive bone losses were the major challenges for the long term success. Substantial changes in implant fixation increased the durability of femoral and acetabular components. Newer cementing techniques on the femoral side including the use of a medullary plug, a cement gun, lavage of the canal, pressurization, centralization of the stem, and reduction in porosity in the cement allowed to reduce stresses in the materials and improved strength of the interfaces with increasing survival rates up to 95% after ten years [31,32].

Cementless components rely on bone ingrowth into porous or onto roughened surfaces; additionally, several types of calcium phosphate ceramics (often called hydroxyapatite) have been added as coatings to THR surfaces to enhance fixation of non-ingrowth implants to bone [33-35]. Selected cementless femoral components have exhibited clinical success similar to that of cemented components installed with the newer cementing techniques [36,37]; however, so far the follow-up is much shorter.

On the acetabular side, the cementless components have demonstrated less long-term aseptic loosening compared with the cemented components. Since most prospective and retrospective studies have focused only on specific device designs and techniques, any general comparison of cemented and non-cemented systems should be viewed with caution [38-40].

There are major differences between countries in regard to the philosophy of implant fixation. While in some countries most THRs are implanted without cement (e.g. Austria 85-90%) [41], in others uncemented THRs are uncommon (Norway 14% [42], Sweden 5% [29]). In most countries the decision for an uncemented THR is based on the age and the bone quality. Based on own evaluations, the estimated rates for cemented THR in Europe are 30-50%, for hybrid THR 10-30%, and for cementless THR 20-40%.

Device design and fixation technique have to guarantee load transfer between pelvic bone and femur. Two aspects are important:
1. The contact area between implant and corticalis has to be as large as possible to avoid load peaks,
2. the point of load transfer should be very proximal to reduce bone atrophy due to inactivity.

Today, the standard design for femoral components consist of stem fixation and diaphyseal load transfer [43,44]. However, recently hip resurfacing has a renaissance and short-stem femoral components are more often in use [45]; so far, due to lack of durable long-term results its use is primarily restricted to some centers.

The main problem in THR unrelated to implant design is aseptic loosening. Most published results are based on single types of prostheses and expert surgeons. In the Swedish THR register some 160 000 cases have been recorded nationwide over the past 20 years. The rate of revisions in this register is low (7.1%) for the cemented group, but considerably higher in the uncemented group (13%).
In revision cases of the femoral component the approach is based primarily on the nature of the remaining bone stock in the proximal femur. In addition, clinical judgment usually takes into account the age and functional demands of the patient. In most cases revision of the femoral component is possible with a cemented stem. However, when there is substantial residual bone stock, non-cemented long-stem high-modular implants, particularly the extensively coated components, are also in use [46-49]. Morselized bone is used in addition to fill defects in the femoral canal or proximal femur.

On the acetabular site, revision strategies depend on the acetabular component, and the presence of adequate bone stock [50, 51]. All types of implants and fixations are in use, often in combination with bone cement, morselized or structural bone graft augmentation [52, 53].

Wear and third-body reaction are still major areas of concern because of resulting implant loosening and failure [54, 55]. In the past, metal to polyethylene articulations have caused catastrophic osteolysis and failure of hip arthroplasties [56, 57]. Newer articulating components (e.g. metal/metal, ceramic/ceramic, ceramic/high-cross-linked polyethylene) are mainly in use with smaller particle sizes and lower wear rates. The decision for different articulation components is on the patient site primarily based on age and demanded and/or expected mobility.

Since length of acute hospital stay has become shorter in the past years, more emphasis is needed to determine the role of preadmission educational programs, as well as appropriate physical therapy and rehabilitation during hospitalization and following discharge.

Post-operative in- or outpatient rehabilitation programs and home-health programs are in use European-wide. They are directed to an early mobilization, gait and balance training as well as muscular restoration. In addition, self-care training and psychological assistance is offered. According to own unpublished evaluations and other sources [30, 41], major regional and cultural differences exist. While in the German-speaking countries the majority of THR patients are discharged to inpatient rehabilitation hospitals for 3–4 weeks, in most of the other health-care systems a combination of in- and outpatient rehabilitation is in use. Inpatient programs seem to be more effective than prolonged hospitalization or outpatient rehabilitation [58]; however, some believe that appropriate home training is at least as good [59]. While the positive influence of a rehabilitation program on short- and mid-term results is proven, the long-term benefits of prolonged therapeutic exercise program for patients who have undergone THR have not been clearly demonstrated to improve mobility or hip stability. There is evidence that hip weakness persists up to 2 years after surgery in the presence of a normal gait. Multiple studies have demonstrated that weakness in the lower extremities is a major risk factor for falls and resulting fractures in the geriatric age group, thus for these patients an extensive rehabilitation seems to be an effective prevention.

Most health-care systems in Europe guarantee easy access to THR for all their people in all regions. The majority of procedures are performed in regional hospitals with 50–300 THR per year and 5–10 orthopedic surgeons; specialized centers with 500–1000 THR or more per year are rare. With demographic changes and more people in the older age groups the number of hip replacements needed will increase. So far, no agreed indication or appropriateness criteria exist that would allow to analyze over- or under-treatment in certain areas and to adjust the appropriate resources.

In regard to introduction of minimally invasive techniques in THR and especially following widespread use, drawbacks of a new learning curve can be expected. All surgeons who are currently performing the new techniques pointed out that these belong into hands of experienced surgeons. Only centers with a high surgical volume can reach the appropriate steady state of the learning curve in a short time. A rapid widespread introduction of minimally invasive approaches might hamper the overall public health due to inappropriate training and inferior results of the less experienced surgeons. For the near future, most hospitals will have to continue with the conventional approaches guaranteeing the long-term success rates of total hip replacements and providing high-quality care to their patients.

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