

## Clinical Practice Guideline

# Total Hip Replacement for Osteoarthritis—Evidence-Based and Patient-Oriented Indications

Klaus-Peter Günther, Stefanie Deckert, Cornelia Lützner, Toni Lange, Jochen Schmitt, Anne Postler

## Summary

**Background:** Total Hip Replacement (THR) belongs to the most common inpatient operations in Germany, with over 240 000 procedures performed per year. 90% of the artificial joints are still functional at 15 years, and up to 60% at 20 years after surgery. It is essential that the indications for such procedures should be uniform, appropriate, and patient-oriented.

**Methods:** This review is based on publications retrieved by a systematic literature search for national and international guidelines and systematic reviews on the topic of hip osteoarthritis and THR.

**Results:** THR should be performed solely with radiologically demonstrated advanced osteoarthritis of the hip (Kellgren and Lawrence grade 3 or 4), after at least three months of conservative treatment, and in the presence of high subjective distress due to symptoms arising from the affected hip joint. Contraindications include refractory infection, acute or chronic accompanying illnesses, and BMI  $\geq$  40 kg/m<sup>2</sup>. Patients should stop smoking at least one month before surgery. In patients with diabetes mellitus, preoperative glycemic control to an HbA1c value below 8% is advisable. It is recommended that patients should lower their weight below a BMI of 30 kg/m<sup>2</sup>.

**Conclusion:** The decision to perform THR should be taken together by both the physician and the patient when the expected treatment benefit outweighs the risks. Evidence suggests that a worse preoperative condition is associated with a poorer surgical outcome.

### Cite this as:

Günther KP, Deckert S, Lützner C, Lange T, Schmitt J, Postler A: Total hip replacement for osteoarthritis—evidence-based and patient-oriented indications. *Dtsch Arztebl Int* 2021; 118: 730–6. DOI: 10.3238/arztebl.m2021.0323

Total hip replacement (THR) is among the most common operations conducted in an inpatient setting, with approximately 240 000 procedures performed in Germany in 2019 (1). Along with proximal femoral fractures, hip osteoarthritis (hip OA) is the most common disease of the hip joint, treated by hip replacement surgery.

Depending on the stage of the disease, there are a variety of non-surgical and surgical treatment options available for the management of hip osteoarthritis (2). Apart from pharmacological therapy, patient education and exercise therapy as well as maintaining physical activity, are particularly important during the initial stages of the disease. Evidence suggests that for mild to moderate symptoms it is possible to delay THR surgery for some time (median time 5.4 years) by combining these two types of therapy (3). When symptoms deteriorate in the advanced stage, THR is one of the most successful and effective treatment options (2, 4). Data from the British National Joint Registry (NJR), which has been collecting patient-reported outcomes since 2009, show that 97.5% of patients reported an improvement in hip pain and function (increase of 153% from a median of 17 to 43 points as measured by the Oxford Hip Score) (5).

According to a meta-analysis from 2019, survival of joint replacement constructs of 89.4% can be expected after 15 years, of 70.2% after 20 years, and of 57.9% after 25 years (6). Also, the risk for surgical complications in the inpatient setting (1.51% for general complications and 2.35% for specific complications) and a mortality risk of 0.04% can be regarded as very low (7).

The frequency of THR performed in Germany differs from region to region. It varies in the individual federal states by a factor of 2.8. Higher rates are found in the south and the northwest (8). One possible reason for this variability is the absence of standardized decision criteria as basis for the indication of THR in a transparent and consistent way. (8). Therefore, the guideline project “Evidence-based and consensus-based indication criteria for total hip replacement (EKIT hip)” was initiated under the auspices of the German Society for Orthopedic and Trauma Surgery (DGOU) and the German Society for Endoprosthetics (AE) (9).

University Center of Orthopaedics, Traumatology & Plastic Surgery, University Medicine Carl Gustav Carus Dresden, Germany Prof. Klaus-Peter Günther MD, Dr. rer. medic. Cornelia Lützner, University Lecturer Dr. Anne Postler MD

Center for Evidence-Based Healthcare, University Medicine Carl Gustav Carus Dresden and the Medical Faculty Carl Gustav Carus of the Technical University Dresden: Stefanie Deckert, Toni Lange, Prof. Jochen Schmitt MD

The aim was to compile recommendations for indication and contraindication criteria, based on current evidence and agreed by general consensus, and to develop a practical guideline. In order to justify their generally binding character, the agreed recommendations should meet the requirements of the S3 level of clinical-practice guidelines, follow an action-guiding algorithm, and be easy to implement in medical practice.

### Methods

Twenty-nine representatives from 23 professional societies/organizations participated in the guideline project (*eBox*). Firstly, a systematic literature search was conducted for national and international guidelines on hip osteoarthritis and THR (last update January 2020). The methodological quality of the related guidelines was assessed using the German guideline assessment tool (DELBI) by two reviewers independently of each other. (10). Secondly, the authors conducted a systematic literature search of systematic reviews and meta-analyses (referred to here as “Overview”) listed in Medline (via Pubmed) and Embase (via Ovid) databases covering the terms “hip joint” and “joint prosthesis” or “hip replacement” (last update August 2020). Screening of the identified hits was performed independently by two reviewers, applying several inclusion criteria for key questions that were prepared according to the PICO model. A structured assessment of the included reviews was conducted using AMSTAR 2 guidelines (11).

### Results

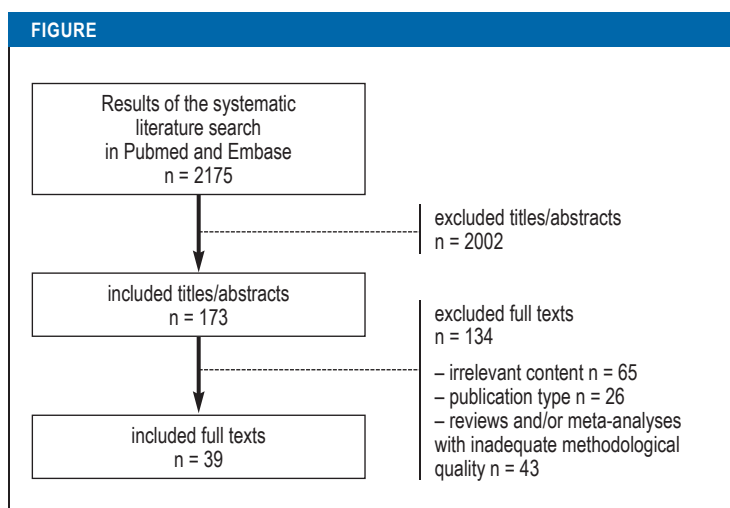
The guideline search identified 18 guidelines of which ten were considered methodologically adequate according to DELBI criteria and therefore included (2, 4, 12–19). A total of 39 relevant systematic reviews (33 with meta-analysis) out of 2175 hits were identified for extraction of the evidence (*Figure*). According to the AMSTAR criteria, three were of high quality, eight were of adequate quality, and 28 were of lower quality. The level of evidence (LoE) of the included papers varied between 1+ and 2+ (according to the Scottish Intercollegiate Guidelines Network, SIGN), with one meta-analysis (LoE 1+) (20) and six meta-analyses (LoE 1–) based on randomized controlled trials (RCTs) (21–26) and one meta-analysis based on cohort studies (LoE 2++) (27). A further 31 systematic reviews, which included cohort studies, corresponded to evidence level 2+.

The recommendations were structured according to six subject complexes, the sequence of which can serve as a practical decision-making aid (*Box*).

### Guideline recommendations

The recommendations were defined from the search results as follows:

- a) evidence-based (the literature used is based on the results of the overview) or



Flowchart: Literature search

- b) based on guideline adaptation or taking guideline(s) into account, i.e. one or more recommendations from the included guidelines were used as a recommendation basis.

The strength of recommendation is marked in the text with “↑↑” (strong recommendation, level A) or “↑” (weak recommendation, level B). Where evidence is lacking or incomplete, recommendations are identified as “EC” (expert consensus).

### Diagnosis confirmation (objective requirement)

If typical symptoms of hip osteoarthritis are present, the diagnosis should be established sequentially, first by taking a targeted history (hip pain, morning stiffness less than 60 minutes) and then by a physical examination of the hip joint (painful internal rotation, limited flexion) (EC) (2). Relevant differential diagnoses should be considered and ruled out. This is particularly indicated in younger age groups to clarify the possibility of joint-preserving surgery (↑↑, guideline adaptation) (15). Otherwise, conventional radiographs (standard anterior-posterior pelvic view and a second projection of the hip joint) should be obtained, at the latest when hip symptoms persist despite non-surgical therapy (EC).

This expert consensus takes into account the consensus-based recommendations of the European League Against Rheumatism (EULAR) (18), which found no evidence of additional value or superiority of imaging as compared with clinical examination alone in osteoarthritis of the hip. Nevertheless, the indication for THR should only be established after radiological confirmation of osteoarthritis. The irreversibility of the procedure and the potential risks mean that surgery is usually only indicated for advanced osteoarthritis of the hip (Kellgren-Lawrence [KL] grade 3 or 4, *Figure*) (↑↑, evidence-based). This recommendation is based on two systematic reviews, which reported evidence for a

BOX

**Algorithm for establishing the indication for THR in osteoarthritis of the hip**

**1. Diagnosis confirmation (objective requirements)**

- History (hip pain, morning stiffness <60 min.) and specific examination (painful internal rotation, reduced flexion)
- Radiologically confirmed osteoarthritis of the hip from KL grade 3
- Radiologically confirmed avascular necrosis of the femoral head from ARCO IIIc

**2. Patient's subjective distress (personal need)**

- Symptoms of hip osteoarthritis:
  - pain
  - limitations of function/ADL
  - restrictions of health-related quality of life
- Assessment using validated instruments for patient-reported outcome measures (PROMs)
- High level of distress despite non-surgical treatment, see 3.

**3. Assessment of alternative treatment options**

- Completed pharmacological and non-pharmacological therapy ≥3 months
- Core elements of non-pharmacological therapy:
  - patient education
  - exercise therapy
  - weight reduction for overweight/obesity

**4. Contraindications**

- Previous, not eradicated infection of the hip joint
- Active infection (joints, soft-tissues, hematogenous spread)
- Acute or chronic comorbidities
- BMI ≥40 kg/m<sup>2</sup>

**5. Optimization of modifiable risk factors**

- No nicotine use for ≥1 month
- Diabetes mellitus: HbA1c <8%
- Recommendation for weight reduction for BMI ≥30 kg/m<sup>2</sup>
- Specialist consultation of suspected mental disorder
- Anemia diagnostics and, if confirmed, treatment
- No intra-articular corticosteroid injection for ≥6 weeks

**6. Shared decision-making**

- Identification of individual treatment goals
- Information on the feasibility of these goals
- Patient-friendly information
- Jointly reached decision

poorer postoperative outcome in lower-grade osteoarthritis, although the included studies were heterogeneous (28, 29).

However, there are also borderline cases (e.g. dysplasia, femoroacetabular impingement) which are only detectable on MRI and represent an indication for THR despite radiographically lower grade osteoarthritis. Therefore, additional imaging using MRI and/or CT should only be obtained if there is a discrepancy between clinical and radiographic findings (EC, guideline adaptation) (18). The same applies to avascular necrosis of the femoral head, for which, according to the S3 guidelines “Non-traumatic avascular necrosis of the femoral head” (13), THR may be indicated from at least stage IIIc of the International Association for Bone Necrosis (ARCO), even without advanced signs of osteoarthritis (↑, guideline adaptation).

**Patient's subjective distress (personal need)**

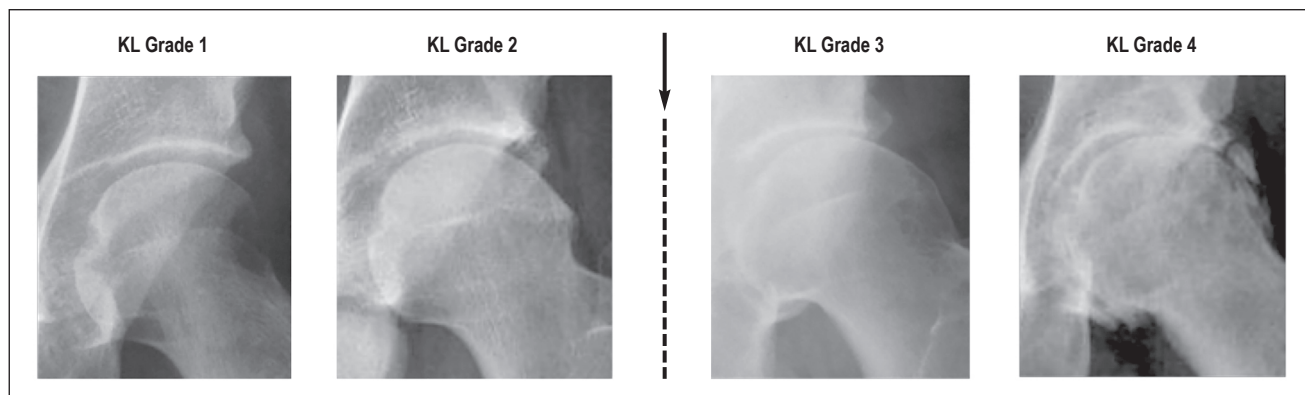
Apart from clinical and radiographic evaluation of hip osteoarthritis severity, an assessment of the patient's subjective distress and hip osteoarthritis-related symptoms is also needed:

- Pain
- Limitations of function and activities of daily living
- Restrictions of health-related quality of life (↑↑, guideline adaptation) (14, 15).

These evaluations are not only relevant for the assessment of treatment outcomes (non-surgical and/or surgical), but also for the process of shared-decision-making for or against surgery. Validated patient-reported outcome measurement (PROM) instruments should be used wherever possible (↑↑, evidence-based). The AE has published consensus-based recommendations for outcome measurements in artificial hip and knee replacement (30). The recommendation of the Oxford Hip Score (OHS) or alternative measurement tools (WOMAC, HOOS or HOOS-PS) as well as a generic score (e.g. EQ-5D, SF-12, SF-36) applies primarily when conducting clinical trials but can also be extended to cover general use. German translations are available for the PROMs mentioned; these are partly subject to a license fee for their commercial use (30).

The question for the appropriate time for surgery is important, both for patients and physicians. There are a number of studies looking at the impact of the degree of preoperative complaints on the likely postoperative treatment outcome (15, 28, 29, 31).

The study evidence does not allow any clear statement as to whether a poor preoperative condition produces a less favorable outcome after THR. But there are clear trends showing that patients in a worse condition before surgery (pain, function, comorbidities and quality of life) do not achieve the same good level after surgery as patients who undergo THR earlier in the disease process (32). A delay of THR must therefore be considered just as thoroughly as an early



**Figure: Radiological stages of osteoarthritis of the hip** according to the Kellgren-Lawrence score (KL). As a rule, THR surgery should only be performed for advanced hip osteoarthritis (grade 3 or 4).

indication without adequately meeting the indication criteria (for example, low radiological grade and/or insufficiently conducted non-surgical therapy). This should be well considered during the informed consent discussion, taking into account the individual symptom severity (↑↑, evidence-based).

Ultimately, a high level of subjective distress from hip-related complaints (pain, limitations in function and activities of daily living) and restrictions in health-related quality of life and the presence of the other indication criteria (radiographic evidence of hip osteoarthritis KL grade 3, prior non-surgical therapy with a combination of pharmacological therapy and non-pharmacological therapy for three months) is a strong justification for THR (↑↑, guideline adaptation) (15).

#### Assessment of alternative treatment options (assessment of appropriateness)

The recommendation of combining pharmacological and non-pharmacological therapy for non-surgical management of patients with hip osteoarthritis (↑↑, guideline adaptation) is supported by a total of six of the included guidelines (2, 4, 12, 14–16). Patients should have at least carried out, or should have been recommended, the following core elements of conservative non-pharmacological therapy:

- Patient education (information, education and counseling about the disease)
- Exercise therapy and enhancement of physical activity
- Weight reduction in patients with overweight and obesity (↑↑, guideline adaptation).

The evidence base for the first two core elements is comprehensive and of high quality. The UK guideline cites the significant effect of providing disease-specific information (treatment programs, self-management programs, training, leaflets) on pain relief, reduction of pain medication, improved quality of life, and self-help – including two meta-analyses and six randomized controlled trials (RCTs) (15).

The most recent guidelines of the Osteoarthritis Research Society International (OARSI) report eight RCTs showing significant effects of exercise therapy on pain relief, improvements of function and activity (4).

THR should be indicated when a high subjective level of distress persists for at least three months, despite guideline-based non-surgical therapy (↑, evidence-based). This recommendation is based on two high-quality meta-analyses (20, 22). In a Cochrane review, Fransen et al. (20) examined ten RCTs that compared exercise therapy (strengthening and stretching exercises, cardiovascular training) with a control group without exercise therapy. A significant treatment effect was demonstrated for pain relief (9 RCTs, n = 549, standardized mean difference [SMD] -0.38, 95% confidence interval [-0.55; -0.20]) and functional gain (9 RCTs, n = 521, SMD -0.38, [-0.54; -0.05]) immediately after treatment.

Analysis of five RCTs on the sustainability of the effects over three to six months also found significant results (pain relief n = 391, SMD -0.38 [-0.58; -0.18] and functional gain n = 365, SMD -0.37 [-0.57; -0.16]). In their analysis of 77 RCTs on hip and knee osteoarthritis (comparison of intervention groups with additional therapeutic exercise with control groups without additional therapy), Goh et al. (22) found that the positive effects in terms of pain, improvement in function and activity, and increase in quality of life through additional exercise peaked after eight weeks and decreased afterwards. There was no difference from the control group after about 9 to 18 months.

#### Contraindications

The proportion of patients with an absolute contraindication for THR surgery is comparatively low. Given the increased risk of infection, revision and mortality, the indication for THR should not be made, or should be delayed, and should be reviewed particularly critically in the presence of the following factors:



- previous, not eradicated infection of the hip joint
- acute or chronic comorbidities and
- morbid obesity (body mass index [BMI]  $\geq 40$  kg/m<sup>2</sup>).

Before performing a THR, an active infection of the affected hip joint as well as of the surrounding soft tissues must be ruled out (↑↑, guideline adaptation). The Second International Consensus Meeting on Orthopedic Infections (2<sup>nd</sup> ICM) (17) justifies this recommendation with the data of Pugely et al., who reported a 5-fold increased probability of periprosthetic joint infection within 30 days after surgery following a previous wound infection (n = 23 128 total hip and knee replacement, OR 5.0 [2.3; 10.9]) (33).

Active infections at other sites (hematogenous spread, local tissues, joints) should have healed before THR is performed (↑↑, guideline adaptation) (17). There is strong evidence for this recommendation (17 observational studies), which consistently showed a significantly increased risk of infection after surgery. A thorough medical history (infectious diseases, immunosuppressant medication usage, alcohol and nicotine addiction) and physical examination (dental, venous, skin status) as well as blood tests (CRP, white blood cell count, blood glucose, HbA1c) or, if necessary, joint aspiration are used to confirm absence of infection.

The association between a BMI  $\geq 40$  kg/m<sup>2</sup> and a strongly increased risk of periprosthetic joint infections may be considered confirmed (three meta-analyses):

- for septic revisions (n = 10 325, relative risk 9.8 [3.6; 26.6]) (34)
- for periprosthetic infections (n = 8253, RR 8.5 [3.5; 20.7]) (35) and (n = 24 134, RR 3.7 [2.3; 6.0]) (27).

The 2<sup>nd</sup> ICM also rates the evidence for an increased risk of wound and periprosthetic infection with increasing BMI as reliable (17). Patients with a BMI  $\geq 40$  kg/m<sup>2</sup> should undergo a particularly critical risk-benefit analysis of the intervention (↑↑, evidence-based and guideline adaptation).

### Optimization of modifiable risk factors

Patients have their own individual risk-factor profile that can have a negative impact on perioperative and postoperative complication rates, as well as treatment outcomes and implant survival (36). When planning treatment, it is important to consider whether existing risk factors are modifiable and the individual potential for complications can be reduced. Modifiable risk factors include nicotine addiction, poorly controlled diabetes mellitus, obesity (BMI  $\geq 30$  kg/m<sup>2</sup>), asymptomatic bacteriuria, mental disorders, anemia, and preoperative intra-articular corticosteroid injections. Systematic reviews that show evidence of these risk factors and their impact on postoperative outcomes are presented in *eTable 1*.

- Smokers should be encouraged to abstain from nicotine at least 1 month prior to scheduled THA (↑↑, evidence-based).

- Blood sugar levels of patients with diabetes mellitus should be optimized prior to THR surgery (↑↑, evidence-based). An HbA1c level below 8% should be targeted (EC).
- Patients with a BMI  $\geq 30$  kg/m<sup>2</sup> should be advised to lose weight prior to THR surgery (↑, evidence-based and guideline adaptation).
- An asymptomatic bacteriuria should not be treated prior to a scheduled THA (↑↑, evidence-based).
- Patients with a suspected mental disorder should be advised to seek specialist consultation prior to THR surgery (EC).
- Prior to performing THA surgery, anemia diagnostics as well as therapy should be performed if the latter is required (↑↑, evidence-based and guideline adaptation).
- After intra-articular injection of corticosteroids, THA surgery should be performed at the earliest 6 weeks after injection; a three-months delay is recommended, however (↑, evidence-based).

### Shared decision-making

The patient's willingness to undergo joint replacement and the physician's assessment of its necessity do not always match (37). During the shared decision-making process, the patient's individual expectations and goals should be identified and documented (EC) and their actual feasibility by means of THR should be discussed (EC). These include the expected benefits in terms of postoperative outcome (pain relief, improvement in function, activity and quality of life), the surgical risks in general as well as the individual risk profile and the likelihood of achieving individual goals. Patient-friendly information material should assist the informed consent process (EC). Finally, the consultation should conclude with a jointly reached decision for or against surgery. It should be agreed on that the expected benefits of surgery outweigh its potential risks (EC).

The recommendations were incorporated in a practical checklist (*eTable 2*) to support guideline implementation.

### Acknowledgments

The literature research on which the guidelines are based was supported by project funds from the German Endoprosthetics Foundation.

The authors would like to thank the guideline group – including Prof. Jörg Lützner MD and Dr. Natascha Einhart MD – for their excellent collaboration during the guideline development process.

We would also like to thank all the representatives of professional societies and organizations involved in the consensus process, as well as Dr. Monika Nothacker MD for the support given on the part of the AWMF (*eBox*).

### Conflict of interest statement

Prof. Günther was remunerated for an authorship by Orthopedics and Trauma Surgery Up2date. In writing the present manuscript, he was supported by the German Endoprosthetics Foundation. He was remunerated by Zimmer Biomet, AE, and OrthoTraumaUpdate for the preparation of scientific meetings. He received funding from Zimmer Biomet and the German Endoprosthetics Foundation to conduct contracted clinical studies and a research project which he initiated.

The other authors declare that they have no conflicts of interest.

Manuscript received on 1 June 2021, revised version accepted on 17 August 2021

Translated from the original German by Dr. Grahame Larkin, MD

As with many other professional journals, clinical guidelines in the German Medical Journal are not subject to the peer review process since S3 guidelines are already texts that have been assessed and discussed by experts (peers) and already have a broad consensus.

**References**

1. Statistisches Bundesamt (Destatis): Fallpauschalenbezogene Krankenhausstatistik (DRG-Statistik). Operationen und Prozeduren der vollstationären Patientinnen und Patienten in Krankenhäusern (4-Steller). 2019. [www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Gesundheit/Krankenhaeuser/Publicationen/Downloads-Krankenhaeuser/operationen-prozeduren-5231401197014.pdf?\\_\\_blob=publicationFile](http://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Gesundheit/Krankenhaeuser/Publicationen/Downloads-Krankenhaeuser/operationen-prozeduren-5231401197014.pdf?__blob=publicationFile) (last accessed on 31.05.2021).
2. Deutsche Gesellschaft für Orthopädie und Orthopädische Chirurgie (DGOOC): S2k-Leitlinie Koxarthrose (AWMF-Registernummer 033-001) <https://www.awmf.org/leitlinien/detail/II/033-001.html> (last accessed on 20 September 2021).
3. Svege I, Nordsletten L, Fernandes L, Risberg MA: Exercise therapy may postpone total hip replacement surgery in patients with hip osteoarthritis: a long-term follow-up of a randomised trial. *Ann Rheum Dis*. 2015; 74: 164–9.
4. Bannuru RR, Osani MC, Vaysbrot EE, et al.: OARSJ guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. *Osteoarthritis Cartilage* 2019; 27: 1578–89.
5. National Health Service (NHS) Digital: Finalised patient reported outcome measures (PROMs) in England for hip and knee replacement procedures (April 2019 to March 2020) <https://digital.nhs.uk/data-and-information/publications/statistical/patient-reported-outcome-measures-proms/finalised-hip-and-knee-replacement-april-2019--march-2020> (last accessed on 02 August 2021).
6. Evans JT, Evans JP, Walker RW, Blom AW, Whitehouse MR, Sayers A: How long does a hip replacement last? A systematic review and meta-analysis of case series and national registry reports with more than 15 years of follow-up. *Lancet* 2019; 393: 647–54.
7. Institut für Qualitätssicherung und Transparenz im Gesundheitswesen (IQTIG): Qualitätsreport 2020. [https://iqtig.org/downloads/be-richte/2019/IQTIG\\_Qualitaetsreport-2020\\_2021-02-11.pdf](https://iqtig.org/downloads/be-richte/2019/IQTIG_Qualitaetsreport-2020_2021-02-11.pdf) (last accessed on 20 September 2021).
8. Schäfer T, Pritzkeleit R, Jeszenszky C, et al.: Trends and geographical variation of primary hip and knee joint replacement in Germany. *Osteoarthritis Cartilage* 2013; 21: 279–88.
9. Lütznert C, Günther KP, Postler A, Schmitt J: Indikationskriterien zur Hüft-TEP bei Coxarthrose. Konsenskonferenz zur Leitlinie EKIT-Hüfte. *Orthopädie und Unfallchirurgie* 2021; 11: 47–9.
10. Thole H, Lelgemann M, Ollenschläger G, Expertenkreis CQ: DELBI–Das Deutsche Leitlinien-Bewertungs-Instrument–Anforderungskatalog und Prüfinstrument in neuer Form. *Das Gesundheitswesen* 2005; 67: VF\_P61.
11. Shea BJ, Reeves BC, Wells G, et al.: AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ* 2017; 358: j4008.
12. American Academy of Orthopaedic Surgeons (AAOS): Management of osteoarthritis of the hip. Evidence-based Clinical Practice Guideline. [https://www.aaos.org/globalassets/quality-and-practice-resources/osteoarthritis-of-the-hip/oa-hip-cpg\\_6-11-19.pdf](https://www.aaos.org/globalassets/quality-and-practice-resources/osteoarthritis-of-the-hip/oa-hip-cpg_6-11-19.pdf) (last accessed on 20 September 2021).
13. Deutsche Gesellschaft für Orthopädie und Orthopädische Chirurgie (DGOOC): S3-Leitlinie „Traumatische Femurkopfnekrose des Erwachsenen“ (AWMF Registernummer 033-050) <https://www.awmf.org/leitlinien/detail/II/033-050.html> (last accessed on 20 September 2020).
14. Fernandes L, Hagen KB, Bijlsma JW, et al.: EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis. *Ann Rheum Dis* 2013; 72: 1125–35.
15. National Institute for Health and Care Excellence (NICE): Osteoarthritis: Care and management in adults. <http://www.nice.org.uk/guidance/cg177> (last accessed on 20 September 2019).
16. Royal Australian College of General Practitioners: Guideline for the management of knee and hip osteoarthritis. 2nd edn. <http://www.accep.org.au/content/Document/guideline-for-the-management-of-knee-and-hip-0a-2nd-edition.pdf> (last accessed on 20 September 2019).
17. Second international consensus meeting on musculoskeletal infection: proceedings of the second international consensus meeting on musculoskeletal infection: hip and knee. <https://icmphilly.com/wp-content/uploads/2018/11/Hip-and-Knee.pdf> (last accessed on 7 January 2020).
18. Sakellariou G, Conaghan PG, Zhang W, et al.: EULAR recommendations for the use of imaging in the clinical management of peripheral joint osteoarthritis. *Ann Rheum Dis* 2017; 76: 1484–94.
19. Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin (DGAI): S3-Leitlinie Diagnostik und Therapie der präoperativen Anämie (AWMF Registernummer 001 – 0024). <https://www.awmf.org/leitlinien/detail/II/001-024.html> (last accessed on 20 September 2021).
20. Fransen M, McConnell S, Hernandez-Molina G, Reichenbach S: Exercise for osteoarthritis of the hip. *Cochrane Database Syst Rev* 2014; Issue 4, Art. No.: CD007912.
21. Alsaleh K, Alotaibi GS, Almodaimagh HS, Aleem AA, Kourouk CT: The use of preoperative erythropoiesis-stimulating agents (ESAs) in patients who underwent knee or hip arthroplasty: a meta-analysis of randomized clinical trials. *J Arthroplasty* 2013; 28: 1463–72.
22. Goh SL, Persson MSM, Stocks J, et al.: Efficacy and potential determinants of exercise therapy in knee and hip osteoarthritis: a systematic review and meta-analysis. *Ann Phys Rehabil Med*. 2019; 62: 356–65.
23. Yang Y, Li H, Li B, Wang Y, Jiang S, Jiang L: Efficacy and safety of iron supplementation for the elderly patients undergoing hip or knee surgery: a meta-analysis of randomized controlled trials. *J Surg Res* 2011; 171: e201-e7.
24. Li Y, Yin P, Lv H, Meng Y, Zhang L, Tang P: A meta-analysis and systematic review evaluating the use of erythropoietin in total hip and knee arthroplasty. *Ther Clin Risk Manag* 2018; 14: 1191–204.
25. Voorn VM, van der Hout A, So-Osman C, et al.: Erythropoietin to reduce allogeneic red blood cell transfusion in patients undergoing total hip or knee arthroplasty. *Vox Sang* 2016; 111: 219–25.
26. Zhao Y, Jiang C, Peng H, Feng B, Li Y, Weng X: The effectiveness and safety of preoperative use of erythropoietin in patients scheduled for total hip or knee arthroplasty: a systematic review and meta-analysis of randomized controlled trials. *Medicine (Baltimore)* 2016; 95: e4122.
27. Kunutsor SK, Whitehouse MR, Blom AW, Beswick AD: Patient-related risk factors for periprosthetic joint infection after total joint arthroplasty: a systematic review and meta-analysis. *PLoS One* 2016; 11: e0150866.
28. Hofstede SN, Gademan MG, Vliet Vlieland TP, Nelissen RG, Marang-van de Mheen PJ: Preoperative predictors for outcomes after total hip replacement in patients with osteoarthritis: a systematic review. *BMC Musculoskelet Disord* 2016; 17: 212.
29. Lungu E, Maftoon S, Vendittoli PA, Desmeules F: A systematic review of preoperative determinants of patient-reported pain and physical function up to 2 years following primary unilateral total hip arthroplasty. *Orthop Traumatol Surg Res* 2016; 102: 397–403.
30. Lütznert J, Niemeier A, Calliess T, von Roth P: Ergebnismessung in der Hüft- und Knieendoprothetik–Empfehlung der Deutschen Gesellschaft für Endoprothetik (AE). *Zeitschrift für Orthopädie und Unfallchirurgie* 2020; 158: 26–31.
31. Buirs LD, Van Beers LWAH, Scholtes VAB, Pastoors T, Sprague S, Poolman RW: Predictors of physical functioning after total hip arthroplasty: a systematic review. *BMJ Open* 2016; 6: e010725.
32. Judge A, Arden NK, Batra RN, et al.: The association of patient characteristics and surgical variables on symptoms of pain and function over 5 years following primary hip-replacement surgery: a prospective cohort study. *BMJ open* 2013; 3: e002453.
33. Pugely AJ, Martin CT, Gao Y, Schweizer ML, Callaghan JJ: The incidence of and risk factors for 30-day surgical site infections following primary and revision total joint arthroplasty. *J Arthroplasty* 2015; 30: 47–50.

34. Ponnusamy KE, Somerville L, McCalden RW, Marsh J, Vasarhelyi EM: Revision rates and functional outcome scores for severely, morbidly, and super-obese patients undergoing primary total hip arthroplasty: a systematic review and meta-analysis. *JBJS Rev* 2019; 7: e11.
35. Ma Z, Guo F, Qi J, Xiang W, Zhang J: Meta-analysis shows that obesity may be a significant risk factor for prosthetic joint infections. *Int Orthop* 2016; 40: 659–67.
36. Günther KP, Haase E, Lange T, et al.: Persönlichkeitsprofil und Komorbidität: Gibt es den „schwierigen Patienten“ in der primären Hüftendoprothetik? *Der Orthopäde* 2015; 44: 555–65.
37. Postler A, Goronzy J, Günther KP, et al.: Which disease-related factors influence patients' and physicians' willingness to consider joint replacement in hip and knee OA? Results of a questionnaire survey linked to claims data. *BMC Musculoskeletal Disord* 2020; 21: 1–11.

**Corresponding author**

Prof. Klaus-Peter Günther MD, University Center of Orthopedic, Trauma and Plastic Surgery, University Hospital Carl Gustav Carus University at the Technical University of Dresden, Fetscherstr. 74, 01307 Dresden, Germany  
 klaus-peter.guenther@ukdd.de

**Cite this as:**

Günther KP, Deckert S, Lützner C, Lange T, Schmitt J, Postler A: Total hip replacement for osteoarthritis—evidence-based and patient-oriented indications. *Dtsch Arztebl Int* 2021; 118: 730–6. DOI: 10.3238/arztebl.m2021.0323

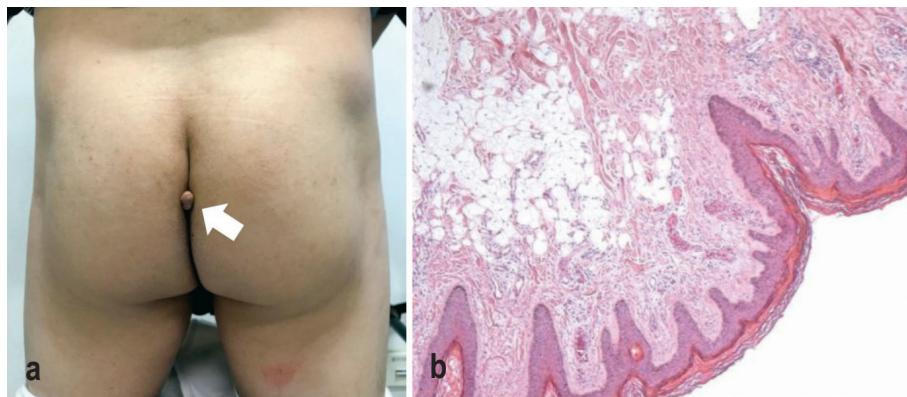
► **Supplementary material**

**eReferences, eTables, eBox:**

[www.aerzteblatt-international.de/m2021.0323](http://www.aerzteblatt-international.de/m2021.0323)

**CLINICAL SNAPSHOT**

**Perianal Localized Nevus Lipomatosus Cutaneus Superficialis**



**Figure:** (a) Physical examination showed a pediculated mass measuring approx. 1.5 × 1.0 cm in the perianal region; (b) Postoperative histological analysis confirmed the diagnosis of nevus lipomatosus cutaneus superficialis.

A 48-year-old man with a 3-year history of perianal mass presented to our institution with a growth in the perianal region gradually increasing in size. Physical examination revealed a pediculated mass measuring approx. 1.5 × 1.0 cm, soft and with no hardened areas, pressure sensitivity, or excessive heat. Considering the volume of the mass and the possibility of malignant transformation, surgical excision was performed at. The postoperative pathology result was consistent with nevus lipomatosus cutaneus superficialis (Hoffmann-Zurhelle). The postoperative one-month follow-up visit was uneventful and showed no postoperative complications.

lipomatosus cutaneus superficialis (NLCS) is an extremely rare benign hamartomatous skin tumor characterized by dermal deposition of mature adipose tissue. We recommend surgical excision of the NLCS if the lesion is rapidly enlarged or occurs at a site susceptible to malignant transformation.

**Xi Zhou\***, MD, **Shuzhong Liu\***, MD, **Yong Liu**, MD, Department of Orthopaedic Surgery, Peking Union Medical College and Chinese Academy of Medical Sciences, Beijing, China; liuyong\_pumch@163.com.

\*These authors contributed equally to this work..

**Conflict of interest statement:** The authors declare that no conflict of interest exists.

Translated from the original German by Christine Rye.

**Cite this as:** Zhou X, Liu S, Liu Y: Perianal localized nevus lipomatosus cutaneus superficialis. *Dtsch Arztebl Int* 2021; 118: 736. DOI: 10.3238/arztebl.m2021.0073

Supplementary material to:

# Total Hip Replacement for Osteoarthritis— Evidence-Based and Patient-Oriented Indications

by Klaus-Peter Günther, Stefanie Deckert, Cornelia Lützner, Toni Lange, Jochen Schmitt, and Anne Postler

Dtsch Arztebl Int 2021; 118: 730–6. DOI: 10.3238/arztebl.m2021.0323

## References

- e1. Bedard NA, DeMik DE, Owens JM, Glass NA, DeBerg J, Callaghan J: Tobacco use and risk of wound complications and periprosthetic joint infection: a systematic review and meta-analysis of primary total joint arthroplasty procedures. *J Arthroplasty* 2019; 34: 385–96.e4.
- e2. Kunutsor SK, Whitehouse MR, Blom AW, Beswick AD: Patient-related risk factors for periprosthetic joint infection after total joint arthroplasty: a systematic review and meta-analysis. *PLoS One* 2016; 11: e0150866.
- e3. Teng S, Yi C, Krettek C, Jagodzinski M: Smoking and risk of prosthesis-related complications after total hip arthroplasty: a meta-analysis of cohort studies. *PLoS ONE* 2015; 10.
- e4. Barrett MC, Whitehouse MR, Blom AW, Kunutsor SK: Host-related factors for venous thromboembolism following total joint replacement: a meta-analysis of 89 observational studies involving over 14 million hip and knee replacements. *J Orthop Sci* 2019; 25: 267–75.
- e5. Cherian JJ, Jauregui JJ, Banerjee S, Pierce T, Mont MA: What host factors affect aseptic loosening after THA and TKA? *Clin Orthop Relat Res* 2015; 473: 2700–9.
- e6. Singh JA: Smoking and outcomes after knee and hip arthroplasty: a systematic review. *J Rheumatol* 2011; 38: 1824–34.
- e7. Kong L, Cao J, Zhang Y, Ding W, Shen Y: Risk factors for periprosthetic joint infection following primary total hip or knee arthroplasty: a meta-analysis. *Int Wound J* 2017; 14: 529–36.
- e8. Podmore B, Hutchings A, van der Meulen J, Aggarwal A, Konan S: Impact of comorbid conditions on outcomes of hip and knee replacement surgery: a systematic review and meta-analysis. *BMJ Open* 2018; 8: e021784.
- e9. Shohat N, Muhsen K, Gilat R, Rondon AJ, Chen AF, Parvizi J: Inadequate glycemic control is associated with increased surgical site infection in total joint arthroplasty: a systematic review and meta-analysis. *J Arthroplasty* 2018; 33: 2312–21.e3.
- e10. Tsang ST, Gaston P: Adverse peri-operative outcomes following elective total hip replacement in diabetes mellitus: a systematic review and meta-analysis of cohort studies. *Bone Joint J* 2013; 95-b: 1474–9.
- e11. Yang L, Sun Y, Li G, Liu J: Is hemoglobin A1c and perioperative hyperglycemia predictive of periprosthetic joint infection following total joint arthroplasty?: a systematic review and meta-analysis. *Medicine (Baltimore)* 2017; 96: e8805.
- e12. Zeng Y, Shen B, Yang J, Zhou Z, Kang P, Pei F: Preoperative comorbidities as potential risk factors for venous thromboembolism after joint arthroplasty: a systematic review and meta-analysis of cohort and case-control studies. *J Arthroplasty* 2014; 29: 2430–8.
- e13. Ma Z, Guo F, Qi J, Xiang W, Zhang J: Meta-analysis shows that obesity may be a significant risk factor for prosthetic joint infections. *Int Orthop* 2016; 40: 659–67.
- e14. Haverkamp D, Klinkenbijn MN, Somford MP, Albers GH, van der Vis HM: Obesity in total hip arthroplasty does it really matter? *Acta Orthop* 2011; 82: 417–22.
- e15. Ponnusamy KE, Somerville L, McCalden RW, Marsh J, Vasarhelyi EM: Revision rates and functional outcome scores for severely, morbidly, and super-obese patients undergoing primary total hip arthroplasty: a systematic review and meta-analysis. *JBJS Rev* 2019; 7: e11.
- e16. Yuan K, Chen HL: Obesity and surgical site infections risk in orthopedics: a meta-analysis. *Int J Surg* 2013; 11: 383–8.
- e17. Liu W, Wahafu T, Cheng M, Cheng T, Zhang Y, Zhang X: The influence of obesity on primary total hip arthroplasty outcomes: a meta-analysis of prospective cohort studies. *Orthop Traumatol Surg Res* 2015; 101: 289–96.
- e18. Gómez-Ochoa SA, Espín-Chico BB, García-Rueda NA, Vega-Vera A, Osma-Rueda JL: Risk of surgical site infection in patients with asymptomatic bacteriuria or abnormal urinalysis before joint arthroplasty: systematic review and meta-analysis. *Surg Infect (Larchmt)* 2019; 20: 159–66.
- e19. Wang C, Yin D, Shi W, Huang W, Zuo D, Lu Q: Current evidence does not support systematic antibiotherapy prior to joint arthroplasty in patients with asymptomatic bacteriuria—a meta analysis. *Int Orthop* 2018; 42: 479–85.
- e20. Alsaleh K, Alotaibi GS, Almodaimegh HS, Aleem AA, Kouroukis CT: The use of preoperative erythropoiesis-stimulating agents (ESAs) in patients who underwent knee or hip arthroplasty: a meta-analysis of randomized clinical trials. *J Arthroplasty* 2013; 28: 1463–72.
- e21. Li Y, Yin P, Lv H, Meng Y, Zhang L, Tang P: A meta-analysis and systematic review evaluating the use of erythropoietin in total hip and knee arthroplasty. *Ther Clin Risk Manag* 2018; 14: 1191–204.
- e22. Zhao Y, Jiang C, Peng H, Feng B, Li Y, Weng X: The effectiveness and safety of preoperative use of erythropoietin in patients scheduled for total hip or knee arthroplasty: a systematic review and meta-analysis of randomized controlled trials. *Medicine (Baltimore)* 2016; 95: e4122.
- e23. Voorn VM, van der Hout A, So-Osman C, et al.: Erythropoietin to reduce allogeneic red blood cell transfusion in patients undergoing total hip or knee arthroplasty. *Vox Sang* 2016; 111: 219–25.
- e24. Meng FT, Gong BB, Yang G, Zhang YZ, Ding WY, Shen Y: Intra-articular steroid injections and risk of infection following total hip replacement or total knee replacement: a meta-analysis of cohort studies. *Int J Clin Exp Med* 2016; 9(6): 11002–11008.
- e25. Charalambous CP, Prodromidis AD, Kwaees TA: Do intra-articular steroid injections increase infection rates in subsequent arthroplasty? A systematic review and meta-analysis of comparative studies. *J Arthroplasty* 2014; 29: 2175–80.
- e26. Xing D, Yang Y, Ma X, Ma J, Ma B, Chen Y: Dose intraarticular steroid injection increase the rate of infection in subsequent arthroplasty: grading the evidence through a meta-analysis. *J Orthop Surg Res* 2014; 9: 107.



**Participants in the S3 guideline “Evidence-based and consensus-based indication criteria for total hip replacement (EKIT hips)”**

● **EKIT study team**

Prof. Klaus-Peter Günther MD (Orthopedic, Trauma and Plastic Surgery, OUPC, University Medicine of Dresden)  
 Prof. Jochen Schmitt MD (Center for Evidence-Based Healthcare, ZEGV, University Medicine of Dresden)  
 University Lecturer Dr. med. habil. Anne Postler (OUPC, University Medicine of Dresden)  
 Prof. Jörg Lütznér MD (OUPC, University Medicine of Dresden)  
 Dr. rer. medic. Cornelia Lütznér (OUPC, University Medicine of Dresden)  
 Stefanie Deckert (ZEGV, University Medicine of Dresden)  
 Toni Lange (ZEGV, University Medicine of Dresden)

● **Guideline group**

Prof. Martin Aringer MD (German Society for Rheumatology, DGRh)  
 Prof. Antje Bergmann MD / Dr. Natascha Einhart MD (German College of General Practitioners and Family Physicians, DEGAM)  
 Dr. Fritjof Bock MD / Prof. Dr. h. c. Jörg Jerosch MD (German Pain Society)  
 Dr. Hartmut Bork MD (Rehabilitation Section – Physiotherapy of the DGOU)  
 Prof. Karsten E. Dreinhöfer MD (German Network of Health Services Research, DNVF)  
 Corinna Elling-Audersch (German League against Rheumatism, Federal Association, research partner)  
 PD Dr. Stefan Fickert MD (Society for Arthroscopy and Joint Surgery, AGA)  
 Dr. Melanie Foerder MD (AOK PLUS)  
 Prof. Niklaus Friederich MD (German Osteoarthritis Aid)  
 Ute Garske (German League against Rheumatism, Federal Association, research partner)  
 Prof. Dr. med. Ralph Gaulke (German Society for Orthopedic Rheumatology, DGORh)  
 Prof. Dr. med. Erika Gromnica-Ihle (German League against Rheumatism, Federal Association)  
 Dr. med. Holger Haas (Independent expert)  
 Prof. Dr. med. Karl-Dieter Heller (Professional Association for Orthopedics and Trauma Surgery, BVOU)  
 Prof. Dr. Daniela Holle (German Society for Nursing Science, DGP)  
 Dr. rer. nat. Ulrike Kaiser (German Society for Psychological Pain Therapy and Research, DGPSF)  
 PD Dr. med. Stephan Kirschner (German Society for Arthroplasty, AE)  
 Prof. Dr. med. Bernd Kladny (German Society for Orthopedics and Trauma Surgery, DGOU)  
 Prof. Dr. Christian Kopkow (German Society for Physiotherapy Science, DGPTW)  
 Marianne Korinth (German League against Rheumatism, Federal Association, research partner)  
 Dr. Michael Kremer MD (German Society for Trauma Surgery, DGU)  
 Dorothee Krug (Association of Substitute Health Insurance Funds, vdek)  
 Maike Linke, Dipl.-Psych. (German Society of Medical Psychology, DGMP)  
 Dr. Jürgen Malzahn MD (AOK Health Insurance Provider, Federal Association)  
 Dr. Ursula Marschall MD (BARMER Health Insurance Provider)  
 Prof. Georg Matziolis MD / University Lecturer Dr. Eric Röhner MD (Representative of the S2k Guidelines on Hip Osteoarthritis)  
 Vincent Justus Leopold (German Society for Orthopedics and Orthopedic Surgery, DGOOC)  
 University Lecturer Dr. Johannes Schauwecker MD / Prof. Rüdiger von Eisenhart-Rothe MD (German Hip Society, DHG)  
 Prof. Susanne Schwarzkopf MD (German Society for Physical Medicine and Rehabilitation, DGPRM)

● **Moderator**

Dr. Monika Nothacker MD (Association of the Scientific Medical Societies in Germany, AWMF)

● **Editor**

German Society for Orthopedics and Trauma Surgery (DGOU)

● **The management boards of the following professional societies and organizations have approved the guidelines:**

DGOU, DGOOC, DGU, AE, DHG, BVOU, DGORh, AGA, DGRh, DGPRM, DEGAM, German Pain Society, DGPSF, DGP, DGPTW, DNVF, DGMP, German League against Rheumatism, German Osteoarthritis Aid, BARMER GEK, vdek, AOK Federal Association, AOK PLUS

eTABLE 1

**Results of the overview of the risk factors nicotine addiction, diabetes mellitus, obesity, asymptomatic bacteriuria, depression, anemia, and intra-articular corticosteroid injection (IACI) with regard to the postoperative outcome.**

Modifiable risk factor	Risk of ...	Direction	Studies	OR/ RR / WMD / SMD
Nicotine addiction	periprosthetic joint infection	↑	13 retrospective cohort and case-control studies	pooled OR 2.02; 95% CI [1.47; 2.77] (e1)
			3 cohort studies (smokers vs. non-smokers for at least 30 days)	pooled OR 1.52; [1.07; 2.14] (e1)
			8 longitudinal studies	pooled RR 1.83; [1.24; 2.70] (e2)
			4 cohort studies	pooled RR 3.71; [1.86; 7.41] (e3)
	wound complications	↑	14 retrospective cohort and case-control studies	pooled OR 1.78; [1.32; 2.39] (e1)
	thrombembolic events	↓	5 observational studies	pooled RR 0.56; [0.42; 0.75] (e4)
	aseptic loosening	ns	3 observational studies	pooled OR 1.96; [0.43; 8.97] (e5)
		↑	3 cohort studies	pooled RR 3.05; [1.42; 6.58] (e3)
	postoperative complication in general	↑	2 cohort studies	pooled RR 1.24; [1.01; 1.54] (e6)
			4 cohort studies	pooled RR 2.58; [1.27; 5.22] (e3)
Diabetes mellitus	periprosthetic joint infection	↑	5 observational studies	pooled OR 1.51; [1.33; 1.71] (e7)
			29 longitudinal studies	pooled RR 1.74; [1.45; 2.09] (e2)
			12 observational studies	pooled OR 1.90; [1.32; 2.74] (e8)
			10 observational studies	pooled OR 1.49; [0.94; 2.37] (e9)
			3 observational studies	pooled OR 2.04; [1.52; 2.76] (e10)
			6 retrospective studies	pooled WMD 3.27; [2.86; 3.67] (e11)
	wound complications	↑	3 longitudinal studies	pooled RR 2.57; [1.07; 6.17] (e2)
	revisions	↑	4 observational studies	pooled OR 1.28; [1.02; 1.59] (e8)
	thrombembolic events	ns	6 observational studies	pooled OR 0.78; [0.75; 0.82] (e12)
	mortality (short-term)	↑	4 observational studies	pooled OR 1.26; [1.15; 1.38] (e8)
Obesity (BMI ≥30 kg/m <sup>2</sup> )	periprosthetic joint infection	↑	4 observational studies	pooled OR 2.04; [1.71; 2.44] (e7)
			20 longitudinal studies	pooled OR 1.60; [1.29; 1.99] (e2)
			14 prospective studies (BMI ≥30 vs. <30 kg/m <sup>2</sup> )	pooled RR 2.26; [1.60; 3.20] (e13)
			10 observational studies	pooled OR 0.30; [0.19; 0.49] (e14)
			5 observational studies	pooled RR 3.17; [2.25; 4.47] (e15)
			5 observational studies	pooled WMD 0.32; [0.18; 0.46] (e16)
	aseptic loosening	ns	7 observational studies (BMI ≥30 vs. <30 kg/m <sup>2</sup> )	pooled OR 1.01; [0.73; 1.40] (e5)
		↑	6 observational studies	pooled OR 0.64; [0.43; 0.96] (e14)
	thrombembolic events	↑	16 observational studies (BMI ≥30 vs. <30 kg/m <sup>2</sup> )	pooled RR 1.65; [1.23; 2.22] (e4)
			7 observational studies	pooled OR 0.56; [0.32; 0.98] (e14)
	dislocation	↑	10 observational studies	pooled OR 0.54; [0.38; 0.75] (e14)
			6 prospective cohort studies	pooled RR 2.08; [1.54; 2.81] (e17)
	PROM	↓	6 prospective cohort studies	pooled RR -2.72; [-4.77; -0.67] (e17)
5 observational studies			pooled SMD 4.54; [3.14; 5.93] (e14)	
Asymptomatic bacteriuria (ASB)	periprosthetic joint infection	↑	11 observational studies	pooled OR 2.38; [1.21; 4.67] (e18)
			5 observational studies	pooled RR 2.87; [1.65; 5.00] (e19)

Modifiable risk factor	Risk of ...	Direction	Studies	OR/ RR / WMD / SMD
<b>Depression</b>	infection (deep/superficial)	ns	3 observational studies	pooled OR 1.54; [0.64; 3.69] (e8)
	thrombembolic events	↑	2 observational studies	pooled OR 1.15; [1.02; 1.30] (e8)
	postoperative pain	ns	3 observational studies	pooled OR 1.22; [0.79; 1.87] (e8)
	postoperative function	↓	4 observational studies	pooled OR 1.69; [1.26; 2.28] (e9)
<b>Anemia</b>	ESA administration – effect on blood transfusion	↓	25 RCTs	pooled RR 0.48; [0.38; 0.60] (e20)
			6 RCTs	pooled OR 0.41; [0.28; 0.60] (e21)
			14 RCTs	pooled OR 0.41; [0.28; 0.60] (e22)
	erythropoietin administration – effect on blood transfusion	↓	6 RCTs	pooled RR 0.45; [0.33; 0.61] (e23)
<b>Intra-articular corticosteroid injection (IACI)</b>	periprosthetic joint infection	ns	6 retrospective studies	pooled RR 1.61; [0.96; 2.72] (e24)
			3 longitudinal studies	pooled RR 4.03; [0.75; 21.80] (e2)
			5 retrospective studies	pooled RR 1.59; [0.66; 3.83] (e25)
	wound infection	ns	8 retrospective cohort studies	pooled OR 2.13; [1.02; 4.45] (e26)
			6 retrospective cohort studies	pooled OR 1.75; [0.74; 4.16] (e26)
			5 retrospective studies	pooled RR 1.91; [0.48; 7.56] (e25)

BMI, body mass index; ESA, erythropoiesis stimulating agent; CI, confidence interval; OR, odds ratio; PROM, patient-reported outcome measures; RCT, randomized controlled study; RR, relative risk; SMD, standardized mean difference; WMD, weighted mean difference

eTABLE 2

**Checklist: Indications for THR for osteoarthritis of the hip**

Indication criteria		Yes	No	
<b>Structural damage</b>	At least KL grade 3 hip osteoarthritis (or avascular necrosis of the femoral head at least ARCO IIIc)	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Non-surgical treatment</b>	Combination of pharmacological and non-pharmacological treatment for at least three months	<input type="checkbox"/>	<input type="checkbox"/>	
	Core elements of non-pharmacological treatment completed: information, exercise therapy, weight reduction where necessary	<input type="checkbox"/>	<input type="checkbox"/>	
<b>High level of subjective distress despite non-surgical treatment</b>	Hip-related complaints (pain, limited function) Measuring instrument/score:	<input type="checkbox"/>	<input type="checkbox"/>	
	Health-related quality of life Measuring instrument/score:	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Reason if answer is "No"</b>				
Contraindications		Yes	No	
<b>Active infection</b> (of joints, soft-tissue or hematogenous spread)		<input type="checkbox"/>	<input type="checkbox"/>	
<b>Acute or chronic comorbidities with increased risk of death</b> If "Yes": which?:		<input type="checkbox"/>	<input type="checkbox"/>	
<b>BMI ≥40 kg/m<sup>2</sup></b>		<input type="checkbox"/>	<input type="checkbox"/>	
<b>Other contraindications against surgery</b> If "Yes": which?:		<input type="checkbox"/>	<input type="checkbox"/>	
<b>Reason if answer is "Yes"</b>				
<b>Minimum requirement for THR fulfilled?</b>		<input type="checkbox"/>	<input type="checkbox"/>	
Modifiable risk factors		Not applicable	Yes	No
<b>Nicotine:</b> abstinence recommended for at least 4 weeks before surgery until wound healing completed		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Diabetes mellitus:</b> HbA1c <8%		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>BMI &gt;30 kg/m<sup>2</sup>:</b> weight reduction recommended		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Anemia:</b> optimization completed		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Intra-articular corticosteroid injection:</b> no THR for 6 weeks		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Suspected mental disorder:</b> specialist consultation recommended		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Reason if answer is "No"</b>				
Participative decision-making				
<b>Patient goals</b> Please enter the most important goals expected to be fulfilled by surgery.	Physician's assessment of fulfillment			
	likely	uncertain	unlikely	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Shared decision: THR surgery</b>		<input type="checkbox"/> Yes	<input type="checkbox"/> No	
<b>Reason if answer is "No"</b>				

Help for everyday practice – Check list for establishing indication for THR for osteoarthritis of the hip  
 BMI, body mass index; KL, Kellgren-Lawrence score; ns, not significant; OP, operation; THR, total hip replacement