Question: What are the indications for tibial and femoral osteotomies around the knee?

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Response/Recommendation: Realignment osteotomies around the knee (OAK), that includes high tibial osteotomy (HTO) and distal femoral osteotomy (DFO) can be offered to patients with early onset arthritis of a single compartment and ensuing deformity. Appropriate patient selection and detailed preoperative planning have a direct impact on the results of surgery.The longer recovery and rehabilitation associated with OAK makes it more ideal for younger and active patients who are motivated to receive a non-arthroplasty surgical procedure

Level of Evidence: Low

Rationale

A narrative review of the literature regarding "High tibial osteotomy indications or distal femoral osteotomy indications" was performed through Pubmed (1976-2024) to identify any relevant publications. From the 404 articles initially identified, and after screening, 19 publications satisfied the inclusion criteria and were used to formulate this consensus statement.

Osteotomy around the knee (OAK) has conventionally been considered for young, under 50 years, and active patients[1,2]. Recent studies have considered numerous patient demographic factors that may influence the results of OAK and its indications[3]. It has been shown that similar functional results may occur in patients over the age of 50 and under the age of 40. However, total knee arthroplasty (TKA) is usually considered as the more optimal choice in the older patients. Thus, OAK continues to be utilized for younger patients, particularly in the paediatric population[4]. Because of the long rehabilitation and recovery period, the indication for OAK should be based on the patient's preoperative activity and motivation as well as their age[3,5-7].

Body mass index (BMI) is an important consideration when assessing suitability for OAK[8,9]. Traditionally, OAK is not recommended in patients with a BMI >30, as it is associated with increased micromotion at the osteotomy site, delayed union, and worse functional outcomes[1,7,8]. However, the literature is unclear whether obesity worsens OAK outcomes and increases conversion to TKA[2,7,8]. On the contrary, there is no clear data showing that union is lower in patients with a BMI <20 who are expected to have less micromotion in the osteotomy line[9]. It may be more useful for the clinician to consider the patient's nutritional status[8,9].

Smoking has a negative effect on bone healing, as well as impairing soft tissue healing and hence may increase the risk of infection. These risks should be discussed clearly with the patient[9,10]. However, there is no consensus on how long smoking cessation before and after surgery to minimize the possibility of smoking-related complications[2,9].

Based on the available evidence the severity of preoperative OA adversely affects the clinical outcome and survivorship of OAK[1-3,9,11]. The presence of Ahlback or Kellgren-Lawrence grade 3 or more cartilage erosion in the degenerative compartment, negatively affects the survival

rate of HTO and impact the functional outcomes[1-3]. On the other hand, cartilage damage in the opposite compartment is also a concern when deciding on OAK[11]. Numerous studies noted that the presence of mild OA (ICRS grade 1-2) in the opposite compartment does not compromise the clinical outcomes[9]. It is also unclear whether repair of meniscus root tears diagnosed on preoperative magnetic resonance imaging or arthroscopy has a positive impact on functional outcomes [3,12]. Additionally, there is no clear data on the usefulness of routine arthroscopy before osteotomy, except for patients who may undergo simultaneous cartilage repair and combined ACL reconstruction[3,9,10,13]. However, the preoperative status of the ACL has not been shown to affect outcomes following MOWHTO[13].

Opening wedge OAK has been reported in earlier literature to exhibit delayed healing at the osteotomy site ranging beyond 6 months. However, no systematic review has established superiority of either the closing or opening wedge technique[2,3,9,14,15]. Both opening and closing wedge OAK are considered acceptable with their own purported advantages and benefits, with no definitive evidence in the literature indicating superiority of one over the other. It is very important to evaluate for any associated limb length discrepancy (LLD), and an opening wedge correction may be preferable when the affected limb is shorter; a closing wedge would be preferred when the affected limb is longer, so as not to exacerbate the LLD further[5].

It is known that patellar height decreases, and patellofemoral osteoarthritis (PFJ-OA) progresses after medial open wedge HTO (MOW-HTO), while patellar height does not change after a lateral closed wedge HTO (LCW-HTO)[2,3,14,15]. However, in cases of suspected patellar infra or patellofemoral OA, and in patients requiring greater corrections (>15°), surgeons may consider performing a descending biplane osteotomy or LCW-HTO[3,16].

With the continuous development of implant technology, the debate on the necessity of bone grafting in MOW-HTO continues. Most authors continue to recommend the use of grafts for high-risk patients (obese, smoker or corrections greater than 10 or 12mm), because of their belief that it improves homeostasis, union, and functional outcomes[2,9]. No systematic review has proven the superiority of autograft, allograft or no graft[1]. The results of synthetic grafts are contradictory in the literature and are often associated with delayed union[2,9,11].

Historically, valgus-producing HTOs were planned to correct to Fujisawa's point (62% of the tibial plateau), but there is emerging evidence that the degree of correction should depend on several factors, such as grade of OA, ligamentous instability, additional procedures and alignment of the contralateral limb [1-3,11] In general, the greater the degree of OA, ligament instability, and contralateral knee valgus, the more significant the correction should be (62-67%)[2,11]. In contrast, in a meniscus transplant or cartilage restoration procedure with minimal OA and contralateral knee varus, correction may only need to be 55-60%. The lateral tibial spine has been used as a simple and reproducible bone point when planning valgus-producing osteotomies, with the 55% correction point supported in recent consensus statements[11]. However, patients with neutral to under- or over-correction have worse long-term functional outcomes and significantly more failures[2,3,11,17,18].

It is controversial whether postoperative MPTA >95º is associated with worse functional outcomes[10,11]. On the other hand, there is clear evidence regarding JLO greater than 3°, which occurs when the combined deformity is corrected from a single plane and is characterized by poor functional outcomes and low survival rate[1-3,10,11,19]. However, it has been shown that JLO may be related to the preoperative joint line convergence angle (JLCA)[11,18,19] and a JLCA greater than 3° indicates significant soft tissue laxity and is predictive of outliers after HTO[2,3,19].

The addition of a DFO to MOW-HTO is recommended in the following cases. (a) Preoperative MLDFA > 90° combined with MPTA<87°, (b) MPTA>94° after HTO (c) JLCA>6° (d) a total preoperative tibial plateau inclination (PI) > -10° and (e) a lateral tibial PI>5°[3]. DLO have become more popular with the advent of surgical navigation tools enabling enhanced accuracy, with favourable results to date[6].

The most widely accepted type of PTS corrective osteotomies is the osteotomy performed when PTS>12° and ATT>10 mm in ACL failure[11]. In extreme cases of PTS (>16-20°) or in patients with multiple ACL reconstruction insufficiency in the contralateral knee, and in primary ACL reconstruction PTS corrective osteotomies may also be performed, however it is less accepted[11,17]. On the other hand, in cases where the accompanying varus deformities are above 5°, correction with combined or biplanar osteotomy may be considered[11].

In conclusion, we believe high tibial ostotomy (HTO) is a viable option for patients with early-onset osteoarthritis (OA) symptoms, especially beneficial for younger, active individuals. This surgical intervention is based on the principle of unloading the affected compartment and increasing this load to the opposite compartment. The principal indications for HTO include: (a) in isolation for mechanical axis realignment of tibial origin (normal medial proximal tibial angle (MPTA): 87 ± 3º), (b) chronic ligamentous instability, (c) meniscal deficiency, (d) focal compartmental chondral defects, (e) failed anterior cruciate ligament (ACL) reconstruction in the setting of increased posterior tibial slope malalignment (PTS >12° and >10 mm of anterior tibial translation (ATT)) and (f) posterior cruciate ligament (PCL) / posterolateral corner instability.

The principal indications for DFO, on the other hand, includes: (a) in isolation for mechanical axis realignment of femoral origin (Normal mechanical lateral distal femoral angle (mLDFA): 87 ± 3); (b) in combination with HTO for mechanical axis realignment where HTO alone would result in unacceptable knee joint line obliquity (JLO>3°); (c) patellofemoral instability or maltracking; (d) asymmetric unloading of either medial or lateral tibial plateau for isolated pathology, often post-traumatic.

Relative contraindications of OAK have been described including (a) patients with tricompartmental OA, (b) severe unicompartmental OA (bone-on-bone), (c) flexion contracture >10º and total arc of range of motion (ROM)<120º, (d) tobacco use, and (e) inflammatory arthritis.

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