



Total Joint Replacement and Joint-Saving Techniques for the Treatment of Knee Osteoarthritis: The Problems of Decision-Making

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ABSTRACT

Background: Recently, there has been an increasingly insufficient use of conservative methods of therapy and an unreasonable increase in indications for total replacement of large joints. According to the literature, more than 25% of cases of knee joint replacement could have been avoided if patients had been provided with optimal non-surgical methods of treatment. In addition, orthopedic traumatologists have once more focused on unheralded joint-saving surgeries like corrective osteotomy, arthrodesis, arthroscopic techniques, arthromedullary bypass grafting, distraction of the knee joint, tunneling, or osteoperforation due to an increase in the number of revision surgeries and unsatisfactory results of knee joint replacement.

Aim: This reviewed the international literature on knee joint replacement and consider alternative methods of surgical treatment of knee osteoarthritis.

Materials and Methods: The analysis of international scientific publications on the treatment of osteoarthritis of the knee joint was performed.

Results: Joint-saving surgeries for knee osteoarthritis represent an alternative to arthroplasty and improve the quality of life of patients. Such interventions do not require specialized expensive equipment. The intervention is accompanied by a shorter recovery period, with a lower rate of complications than in the case of the replacement of the affected joint.

KEYWORDS: total knee replacement, joint-saving techniques, arthroscopy, osteoarthritis

INTRODUCTION

According to the current concept of the treatment of osteoarthritis (OA), knee joint replacement (KJR) should be used in patients with advanced stages of the disease in case of ineffective conservative methods [1-3]. However, there has been a recent worldwide tendency toward insufficient use of conservative methods of treatment and unreasonable expansion of indications for total joint replacement of large joints [4]. Thus, in the USA, about a third of KJR surgeries are unreasonable [5]. Russian authors claimed that in 40% of elderly patients with OA, surgical approach is excessively active, that is, a total KJR is not justified [6]. In a retrospective evaluation of the KJR results, D. Sh. Mansurov et al. revealed that in 71 of 253 patients (28.1%), surgery was performed at the OA radiological

stage II with a moderate pain syndrome, which indicates a premature surgical intervention [8]. An unreasonable expansion of indications for total joint replacement of large joints is associated with an increase in the number of postoperative complications and, as a result, dissatisfaction of patients with OA with the surgical treatment outcomes [9].

Cases of unreasonable or premature KJR are mainly associated with the lack of clear indications and contraindications for the surgical treatment of OA, as well as the criteria for selecting patients. Most often, when establishing the need for KJR, an orthopedic traumatologist focuses on his experience and a subjective assessment of the patient's clinical and functional state. According to A.V. Garkavi et al., when determining indications for KJR with a

relatively intact joint function, the articular cartilage condition is of primary importance, which can be assessed by arthroscopy [10, 11]. After analyzing the literature, we identified 10 different variants for indications for KJR. The main components of which were pain, functional disorders, radiographic changes, and the ineffectiveness of conservative therapy. The authors emphasized that specific thresholds or reference values for these parameters are often unspecified, and the level of evidence for the proposed criteria is low. According to H.M. Ghomrawi et al., assessment of the feasibility of surgical intervention in the knee OA revealed that, depending on the variants used for indications for surgery, 7.7% to 31.5% of cases of KJR were unreasonable [12].

A complicated problem is the KJR in patients with comorbid pathology, particularly in the presence of such common endocrine diseases as diabetes mellitus and morbid obesity [13]. Here, the risk of intraoperative and postoperative complications, as well as revision interventions, increases many times over [14-17]. At the same time, the threshold values of weight and height indicators or parameters of carbohydrate metabolism, at which the KJR is not advisable, are unknown.

Thus, when all the possibilities of non-drug and drug therapy are not used, KJR is frequently performed unreasonably or prematurely. The criteria for selecting patients for surgical treatment of the knee OA must be clarified, especially in cases of comorbidity.

An increase in the number of revisions and unsatisfactory results of KJR has led to the fact that in recent years, orthopedic traumatologists paid attention again to unheralded joint-saving surgeries [18]. Joint-saving techniques implemented in the early stages of the disease contribute to slowing down the progression of OA and enable to delay or avoid completely the replacement of the affected joint [19,20].

One of the most well-known joint-saving surgeries is corrective osteotomy, which involves the correction of varus or valgus deviation of the mechanical axis of the lower limb by dissecting the deformed bone, followed by correct anatomical apposition of the fragments. Corrective osteotomy helps redistribute the statodynamic load from the affected segment of the lower limb to a relatively healthy one [21-23]. Corrective osteotomy is advised in physically active patients of working age with the knee OA, a relatively intact functional status of the knee joint, and the absence of severe obesity [24]. Technically, corrective osteotomies for the knee OA are performed at the level of the femur (high tibial osteotomy) or lower leg (low tibial osteotomy). Currently, corrective osteotomies do not require subsequent long-term immobilization of the lower limb due to the use of various fixators, which improves the quality of life of patients as soon as possible after surgery [21].

The advantages of corrective osteotomy are ease of implementation and a relatively low complication rate. In addition, corrective osteotomy can be performed before KJR if it is impossible to spare the joint, which typically improves the results of surgical treatment [25]. Osteotomy with minimally invasive access is less traumatic, reduces the patient's recovery period after the surgery, and is accompanied by a better cosmetic effect compared to the standard technique [26]. For instance, H. Nakayama et al. reported a significant improvement in clinical parameters and physiological alignment of the lower limb axis already in the early postoperative period in patients with the knee OA with severe varus deformity after minimally invasive two-level osteotomy [27].

According to the literature, the efficiency of corrective osteotomy in gonarthrosis is 86% in the short term after surgery and 58% after 5 years, which is mainly due to the development of the knee joint instability accompanied by severe pain [28]. In some cases, after corrective osteotomy, infectious complications, bone nonunion, compartment syndrome, and neurovascular complications occur [29-31]. In addition, in order to avoid insufficient or excessive correction of the limb axis, careful planning is necessary before the surgery with an accurate calculation of the correction value [32,33].

Arthrodesis surgery, which is the complete fusion of joint-forming bones with the use of fixing devices, is another option for joint-saving surgical treatment for knee OA (screws, wires, frames, plates, and external fixation devices). Arthrodesis causes the inability of movements in the operated joint, which is an obvious disadvantage of this surgery, and is also accompanied by a rather high percentage of infectious complications [34]. Arthrodesis also enables to restore the support function of the lower limb and reduce the severity of pain [35]. Currently, attempts are being made to improve the results of the knee joint arthrodesis, in particular, by using arthroscopic techniques [36]. At the same time, nowadays, the knee joint arthrodesis is considered as an extreme option for the treatment of OA in case of failure of conservative methods and unsatisfactory results of KJR or in case of contraindications to it [35,37].

It is noteworthy that arthroscopic techniques have been actively introduced into surgical practice in recent years and enable to increase the scope of medical and diagnostic care. Arthroscopy in knee OA enables to examine intra-articular structures, including determining the severity and nature of cartilage damage, as well as performing revision, decompression of the affected joint, sanitation, and debridement [38-41]. Arthroscopic techniques can be combined with various joint-saving surgeries, which allow achieving positive outcomes in the medium term in patients with stages II–III of the knee OA in 93% of cases [42,43]. In recent years, the arthromedullary bypass surgery technique

has become available for the treatment of knee OA, which involves inserting a special implant (shunt), through which a communication is established between the medullary canal of the tubular bone and the articular cavity. As a result, the adipose tissue of the tubular bones enters the joint cavity and functions as a lubricant between the friction surfaces. According to the literature, the use of arthro-medullary bypass surgery slows down the degenerative-dystrophic progression, increases the resistance of the knee joint cartilaginous tissue to functional loads, and contributes to relief of the pain syndrome [44]. It is noteworthy that arthro-medullary bypass surgery can be performed with the use of arthroscopy.

The knee joint distraction is based on extension of the joint-forming bones by means of an external fixation device for a certain period. This variant of joint-saving surgical intervention is believed to contribute to the restoration of cartilage tissue in the area of the affected joint, while the effect achieved persists up to 5 years after surgery [45]. Distraction provides mechanical unloading of the knee joint and stimulates the natural internal processes of cartilage tissue regeneration, as evidenced by a steady clinical improvement and an increase in the joint space width [46]. According to T. Takahashi et al. , in patients with knee OA under the age of 65 years within the first year after surgery, no differences were revealed in the WOMAC scale and the severity of pain in patients treated with knee joint distraction compared with high tibial osteotomy or total KJR. [47]. Infection prevails in the range of the procedure complications.

Tunneling or osteoperforation of the articular sections of the knee joint is an organ-preserving surgery that involves the formation of holes (tunnels) in the subchondral zone of the joint for the purpose of revascularization, decompression of the affected bone fragments, and stimulation of reparative osteogenesis [48].

Thus, joint-saving surgeries for knee OA represent an alternative to total joint replacement, improve the quality of life of patients, do not require specialized expensive equipment, and are accompanied by a shorter recovery period than when replacement of the affected joint. Due to these beneficial aspects of joint-saving surgeries, they can be recommended for wider use in real clinical practice. Tunneling appears to be a promising available option for joint-sparing surgical treatment of knee OA.

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