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Review Article

The diagnosis and treatment of knee osteoarthritis: a literature review

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Abstract: Knee osteoarthritis (KOA) is a degenerative disease characterized by the deterioration of the articular cartilage, and hyperplasia of the subchondral bone. KOA is the leading cause of knee pain and dysfunction in adults. The incidence of this arthritis has increased year by year, and the corresponding diagnosis and treatment have developed rapidly as well. A typical diagnostic procedure includes an MRI examination, an arthroscopy, an ultrasound and the creation of thermal texture maps. The available treatments are traditional medicine, arthroscopic treatment, surgical treatment, and tuina manipulation therapy. This paper reviews the clinical studies of the aforementioned methods and their strengths and weaknesses. The results indicate that MRI and ultrasound examination can be used as the basis for the initial diagnosis of knee osteoarthritis, but the thermal texture maps system is a better therapy for further examination. Arthroscopic treatment is used as a minimally invasive, low-cost, high-efficiency diagnosis and treatment plan. In addition, patients with complex conditions are recommended to use single or integrated methods for diagnosis and treatment based on specific conditions.

Keywords: Knee osteoarthritis, diagnosis, therapies, tuina manipulation

Introduction

Osteoarthritis (OA) is a chronic, progressive disease with high disability and teratogenicity in the joints. Deterioration of the articular cartilage is the main problem associated with osteoarthritis, which decreases joint space between the two bones [1]. It adds a significant amount of friction between the two bones, which then generates inflammation and triggers pain through the nerve endings in the joint space. It is characterized by the disintegration of the joint matrix and a marked reduction of chondrocytes. Osteoarthritis often occurs in the hands, neck, lower back, knees, and hips. Knee osteoarthritis (KOA) is one of the most typical manifestations of osteoarthritis. The clinical manifestations are joint pain, swelling, stiffness, and other symptoms, which seriously affect the patients' quality of life and cause a huge social and economic burden [2]. One of the main tissues affected by this disease is the articular cartilage, which is a thin tissue covering the bony end in the joint that mainly provides mechanical support and lubrication during joint movement [3]. This disease is more common in middle-aged and older people over the age of fifty. As the aging of China's population increases, the incidence of KOA will gradually increase. In the United States, 15% of the total population suffers from rheumatoid arthritis, of which OA patients account for 43% of the patients [4]. The incidence of arthritis is proportional to an increase in one's age. KOA's prevalence among female patients is higher than that of male patients, and the prevalence rate of people aged over 65 years is 68%.

Magnetic resonance imaging (MRI), arthroscopy examination, high-frequency color ultrasound and thermal texture maps are the four most acceptable types of imaging examinations. These examinations cannot only help diagnose KOA, but they can also assess the severity of joint damage and evaluate disease progression and treatment [5, 6]. Choosing the

right method cannot only help quickly and effectively diagnose the disease and get treatment, but it can also be more cost effective. Conservative treatment and surgical treatment are mainly used in accordance with different degrees of illness. Conservative treatment uses anti-inflammatory drugs and analgesics to relieve pain and reduce inflammation. Intra-articular injections are used to lubricate and protect joints. Arthroscopic treatment can remove joint swelling and restore the function by clearing the knee joint [7]. Surgical treatment restores joint mobility, relieves pain symptoms, and improves patient quality of life by correcting the lower extremity lines, removing joint spasms, and improving abnormal pressure in the inter-articular compartment. This paper gives a brief review of KOA diagnosis and treatment and then examines the strengths and weaknesses of the clinical applications of the various KOA therapies.

Examination and diagnosis

KOA can be diagnosed in four major ways, including magnetic resonance imaging (MRI), arthroscopy examination, high-frequency color ultrasound examination, and the thermal texture mapping system (TlrM).

MRI examination

Magnetic resonance imaging technology is a diagnostic method widely used in the medical field [8, 9]. It is now recognized as a reliable imaging method for the diagnosis of KOA thanks to its high spatial resolution, multi-sequence, multi-parameter and multi-directional scanning features [10-12]. The tissues around the joint can be clearly displayed, including the skin, subcutaneous fat, muscles, tendons, ligaments, synovial membranes, articular cartilage, meniscus, and subchondral edema. The high sensitivity of MRI technology can show early cartilage damage and help to detect early KOA cartilage lesions, which is of great significance for early clinical diagnosis, intervention and treatment. The cartilage sequence imaging technique can also detect diversifications in the bone marrow edema. The diagnostic method uses magnetic field imaging. It does not pose any radiological hazards for the knees, which makes it relatively safe in clinical applications. What's more, in the diagnosis of knee joint diseases, MRI can distinguish small lesions that cannot be distinguished by the naked eye, such as bone contusion. It can also provide a more scientific and accurate basis for the early rehabilitation of patients. MRI can evaluate the synovial, soft tissue, cartilage and other lesions. However, this inspection is more expensive and the repeatability is poorer. Moreover, an MRI examination is sensitive to the patient's body movement and is prone to artifacts, so it is not suitable for emergency or acute patients.

Arthroscopy examination

Arthroscopy is an endoscopic procedure for the diagnosis and treatment of joint disorders. It has been popular since 1970. Arthroscopic treatment is a minimally invasive surgery. It is widely used in knee joint diseases [13]. Arthroscopic treatment is a safe and practical technology with the advantages of less trauma and quicker recovery. Arthroscopy can be applied in almost all parts of the joint. It has unique advantages over the definite diagnosis of joint intractable diseases. Arthroscopy is not only used in the diagnosis of diseases, but also widely used in the treatment of joint diseases. On the other hand, arthroscopic surgery is prone to many complications such as the damage to normal tissue in the joints, the extravasation of irrigation fluid, intra-articular hematoma, phlebitis, nerve damage, etc. Arthroscopy is traumatic and not easily accepted by patients [14].

High-frequency color ultrasound examination

High-frequency color ultrasound with a high resolution can clearly show the soft tissues around the knee. The normal articular cartilage shows a smooth, linear low echo under the ultrasound, covering on the bone surface of the joint [15]. In KOA patients, the ultrasound examination shows a thinning of the articular cartilage, a blurring of the boundary, and an enhanced echo. It has certain clinical significance for damage degrees of articular cartilage damage and prognosis [16, 17]. Ultrasonography is a non-invasive, fast, and affordable imaging technology for the diagnosis of knee osteoarthritis. High-resolution color ultrasound can clearly show the morphology and damage of the cartilage and subchondral articular surfaces. It has high accuracy and specificity for the soft tissue and liquid anechoic zones. However,

ultrasound is of little value in identifying arthritis types. If necessary, a synovial biopsy can be performed under ultrasound guidance to distinguish the type of inflammation [18].

Thermal texture maps system

TIrM is a method for measuring the temperature distribution of the human body. It receives far-infrared radiation from the human body and converts thermal energy into an electrical signal to reveal the human body's distribution of temperature and its changing rules, which can be used to diagnose diseases [19, 20]. It is one of the essences of the "heat" phenomenon. TIrM has rapidly developed in recent years since it was introduced into clinical applications in the 1960s. TIrM is a functional imaging technology [21]. Body temperature is an important factor in evaluating the physiological and pathological states of the body.

This technology can detect the changes in body tissue metabolism, nerve function, and blood circulation. There is an obvious difference in thermal radiation between anomalous and normal tissue [22]. Accurate measurement for the changes in the temperature distribution of the human body can be used to determine the location and size of the lesion, which is of great significance in the diagnosis of KOA. TIrM is different from B-mode, CT, MRI, and other structural imaging technologies. It has dynamic characteristics. Although this technique has the advantages of high sensitivity and specificity, it lacks precise anatomical positioning capabilities [23].

Therapies

KOA can be cured in four main ways, including traditional medicine, arthroscopic treatment, surgical treatment, and tuina manipulation therapy. According to the K-L (Kellgren-Lawrence) classification, the KOA imaging quantitative grading score was divided into 5 grades, from 0 to 4 points respectively. The higher the score is, the more serious the condition is. K-L grading scores are combined with the clinical signs and symptoms of the patients, and the treatment options are as follows [24, 25]. K-L1 level (0 points): The patient advocates for control of the body mass, avoids unreasonable exercise, avoids knee injury from any strong external force, engages in moderate activity, and pays attention to rest. These steps can also be assisted by Chinese acupuncture, physiotherapy, medicine baths or hyperthermia, using the spa, ultrasound, and so on. K-L2 level (1 point): It is recommended to ingest cartilage protection drugs and non-steroidal anti-inflammatory drugs (NSAID). K-L3 level (2 points): patients should try to use multiple lines of joint cavity drug injections, and patients with severe symptoms can also elect to have an arthroscopic clean-up their joint cavities. K-L4 level (3 points) Patients with heavier articular lesions are generally advised to undergo a tibial (femoral) osteotomy or a single hemorrhoidal replacement. K-L5 level (4 points): Patients are advised to undergo a total knee arthroplasty (TKA).

Traditional medicine

Non-steroidal anti-inflammatory drugs: Non-steroidal anti-inflammatory drugs (NSAIDs) act by inhibiting the cyclooxygenase from participating in the synthesis of prostaglandins, thereby controlling the development of inflammation [26]. However, the adverse reactions of NSAIDs limit their long-term use as a first-line clinical drug. The adverse reactions include an increased risk of rash, allergies, cardiovascular blockage, bleeding and renal function damage [27]. The most common gastrointestinal-related complications may have no clinical symptoms. NSAIDs may increase the permeability of the stomach, small intestine, and even cause bleeding, erosion, ulcers, perforation, stenosis, and jejunal dysfunction [28]. NSAIDs play an important role in the treatment of KOA. But because of their adverse reactions, they are gradually being replaced by other drugs, such as articular cartilage protection drugs, including glucosamine sulfate, glucosamine hydrochloride, chondroitin sulfate, and diacerein. These other drugs can also improve a patient's symptoms and delay the degradation of cartilage [29]. They can also reduce the incidence of gastrointestinal adverse events and have a better effect than NSAIDs.

Glucosamine: Jia H. et al. found that the use of articular cartilage protectants is a more suitable pharmacological treatment for KOA [30]. These drugs not only stimulate the cartilage tissue synthesis of proteoglycans and collagen, but they also inhibit the activity of collagenase and proteoglycan degrading enzymes, resulting in the reduction of cartilage proteoglycans and collagen degradation [31]. Glucosamine is a

compound consists of a hydroxyl group of glucose. It is a main component of cartilage tissue. It exists in the form of an amino glycan polymer [32]. The chondro-protective effect of glucosamine is also manifested in its ability to increase hyaluronic acid (HA) in the synovial membrane and maintain normal HA level in the joint cavity. Glucosamine is a commonly used class of natural amino-dextran drugs for the treatment of KOA, which regulates the synthesis of collagen in cartilage and provides mild anti-inflammatory effects [33].

Chondroitin sulphate: Chondroitin sulphate (CS) is a glycosaminoglycan cartilage protector. It is widely used to treat KOA. It can be absorbed into joint cartilage and slow the progression of KOA. Its working mechanism is similar to that of glucosamine [34]. CS can significantly alleviate the symptoms of KOA. It is a substrate for the biosynthesis of the first preferred glycosaminoglycan chain, and it can also produce other cartilage proteoglycans related to cartilage protection [35]. Since proteoglycan plays an important role in cartilage hydrophilic function, the increase of proteoglycan synthesis may contribute to the improvement of KOA. The characteristic of CS treating KOA is to inhibit the reduction of matrix structural proteins, reversing the catabolism rather than the synthesis [36]. The status of the process reduces the production of prostaglandin E2 and interferes with the nuclear factor KBDNA binding to chondrocytes and synovial cells. Compared with placebo, CS is more effective in reducing pain and improving the Lequesne index. However, it increases the risk of diarrhea [37]. Researchers found that the duration of CS treatment takes a long time, but its efficiency was good and gradually increased. Even if the process is stopped after the onset of treatment, the duration of its effect after treatment is longer than the effect of NSAIDs [38]. Although CS is widely used clinically as a remission drug for KOA, its scope of action is limited due to its specific molecular structure.

Arthroscopic treatment

Arthroscopic treatment is effective and it provides a complete view of the knee joint structure [39]. The patient's age, joint mobility, knee joint clearance, and postoperative patient expectations should be considered in the choice of treatments. KOA has a significant effect after arthroscopic clean-up. The success rate of the surgery is about 70% [40]. This surgery provides a better choice for patients with KOA who have high expectations for joint activities. As a minimally invasive technique, arthroscopic treatment has the advantages of small incisions, a beautiful appearance, little pain, and a short postoperative recovery period. It can avoid the long-term, bedridden complications and hardly affects the muscle structure around the joints [41]. At the same time, with the continuous improvement of minimally invasive treatment concepts and the continuous maturity of arthroscopic techniques, the treatment of KOA under arthroscopy is not limited to improving the symptoms, delaying the progression of joint degeneration, and the replacement of knee joint. Not only can it repair local cartilage defects properly, but it also restores the normal histological structure and biomechanical properties of the knee. Yang et al. found that the effect of arthroscopic treatment was closely related to the preoperative good mechanical axis and the number of invasive treatments in previous joints [42]. Jackson and Dieterichs performed a retrospective study about the effect of arthroscopic lavage on 121 patients with different degrees of KOA for 4 to 6 years [43]. It was found that K-L2 and 3 patients had good postoperative results (77% to 100%). Most K-L4 grades have poor postoperative outcomes, with 29% of postoperative patients eventually requiring arthroplasty.

In summary, although arthroscopic treatment techniques have the advantages of less trauma, less postoperative pain, and rapid functional recovery, they are still not suitable for all arthritis patients. The treatment is limited to patients who require high postoperative joint mobility and have low K-L grading [44]. For patients with severe joint disease, poor lower limb alignment, and poor joint clearance, it is more appropriate to use open surgery to correct the force lines and improve the joint space.

Surgical treatment

High Tibial otecOomy (HTO): In 1958, HTO was first used to treat KOA by correcting primary knee deformity. After Coventry published a long-term study of HTO in 1965, the operation was promoted for the treatment of medial compartment arthritis [45]. Osteotomy can change the load distribution of the medial and lateral compartments of the knee joint, which can relieve joint pain and delay the process of joint

degeneration [46]. HTO technology has now been improved, and several different surgical procedures have been implemented based on the type of knee deformity and the degree of disease, including lateral closed wedge osteotomies, medial open wedge osteotomies, dome osteotomies, chevron osteotomy, and the use of external fixators to correct knee deformities [47]. Jeon et al. showed that HTO is a knee-sparing surgery which can relieve pain and enhance the function of KOA patients with a high demand for physical activity [48]. After HTO, the rate of total knee arthroplasty was reduced to 30%. In contrast, both HTO and single knee arthroplasty demonstrated good clinical outcomes and stable long-term efficacy over long-term follow-up visits [49]. However, a review of the literature study found that HTO and single knee arthroplasty have different indications. The ideal indications for HTO include: patient age < 65 years; a normal range of body mass index; less joint damage (no more than K-L4); no patello-femoral arthritis; good joint space and joint stability [50, 51]. Age, body mass index, and the preoperative status of KOA are key factors in optimizing clinical outcomes. They can affect the incidence rate of fatal complications after patients experience HTO.

Unicomdylar Knee Arthroplasty (UKA): Compared with HTO, UKA is better in terms of pain assessment and complication rate. Despite the better joint mobility in HTO patients and the use of HTO for younger patients, UKA is more suitable for elderly patients [52]. In addition, UKA tended to improve long-term patient recovery. It can also provide a better quality of life, shorten recovery time, and reduce the incidence of perioperative complications. For patients over the age of 65, the risk of HTO failure is 1.5 times higher compared to a younger patient [53]. Therefore, compared with HTO, UKA is more suitable for elderly patients. Accurate indications, including age, activity level, KOA classification, and patient selection, are crucial for all KOA patients. In addition, UKA has become a more reliable and more effective treatment method with the advancement of surgical techniques, the design of built-in materials and the improvement of surgical methods [54].

Total Knee Arthroplasty (TKA): As people are paying more attention to the quality of life, more and more patients with KOA will be targeted for treatment. As an alternative treatment to treat KOA in the 20th century, TKA is now a common treatments for KOA in orthopedic surgery [55]. TKA can greatly reduce joint pain in patients with end-stage KOA and improve joint function. The impact of postoperative rehabilitation activities on coronary heart disease risk has also been resolved. It may even have a protective effect on primary heart disease. However, it should be noted that studies have shown that obesity has a negative effect on TKA postoperative outcomes, and it might increase the need for revision surgery, increase recovery costs, and reduce the survival rate of prostheses and focal osteolysis [56, 57].

Tuina manipulation therapy: Tuina manipulation is a clinical treatment for KOA. In the treatment of KOA, direct manipulation is used to relieve the paralysis of the local muscles, release the soft tissue adhesion, and adjust the mechanical balance of the knee [58, 59]. After several generations of development, tuina, as a discipline, is gradually becoming more mature and useful. During the development, various academic schools of massaging, distinctive characteristics, outstanding curative effects, and clear lines of transmission have been gradually formed, among which Ding's tuina manipulation have a profound impact on the development of the national massage business [60]. Unfortunately, Ding's method has rarely been reported to the international community. Therefore, this article describes it in detail for the first time, and hopes to provide a new treatment for KOA.

Professor Yan Juntao is the fourth generation of Ding's tuina Successor. He has studied with Mr.Ding Jifeng for ten years and inherited academic the theories of the Ding's tuina manipulation: one-finger pushing and rolling [61]. The rolling method involves a large area of stimulation. Due to the uniformity, softness, and strong permeability of this method, it can relieve the tension and tendons of muscle producing analgesic substances such as β-endorphin [62]. Yan attaches great importance to the theory of Jinjing and advances a viewpoint of combining a differentiation of diseases, symptoms and the theory of Jinjing with manipulations [63]. He combines the theory of modem rehabilitation and traditional Chinese medical manipulation, and provides the therapeutic principle: gentle

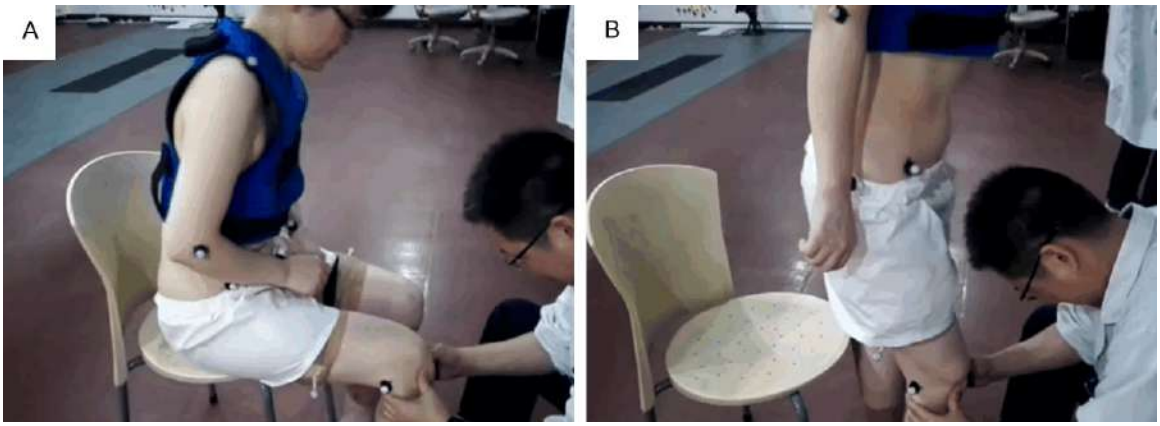

Figure 1. Gentle manipulation makes Jinjing smooth, and forceful manipulation makes Jinjing tense. (A: Massage the knee joint in sitting position. B: Standing with tight pressure.

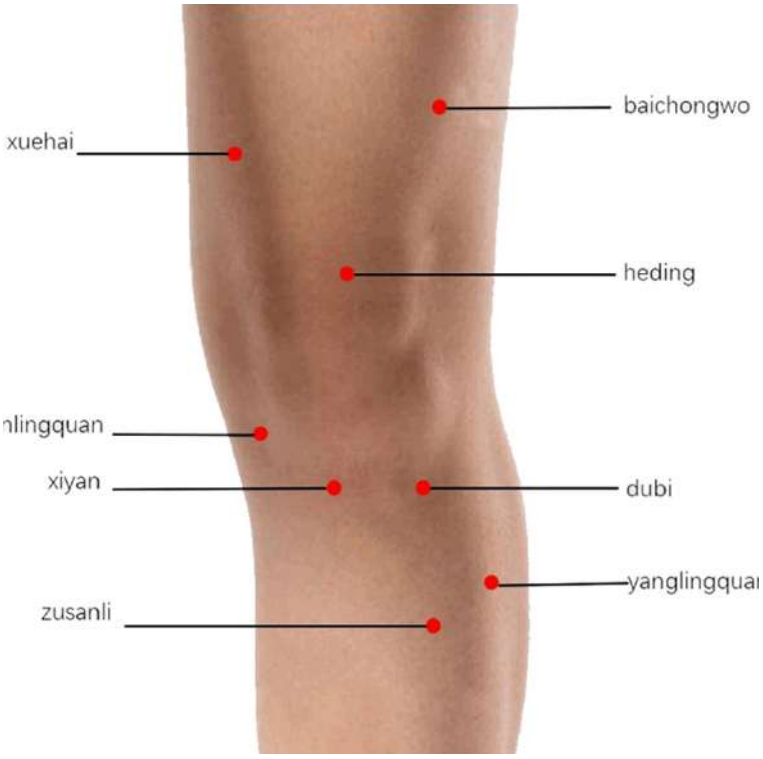

Figure 2. The core differentiation acupoints sites.

manipulation makes Jinjing smooth, and forceful manipulation makes Jinjing tense (**Figure 1**), and gradually forms the academic experience as "treatment based on theory of Jinjing" to cure locomotor and nervous system diseases. Ding's tuina manipulation can promote the blood circulation of the knee joint and effectively improve the internal stasis of the bone [65]. On the one hand, it can provide sufficient nutrients and oxygen for the metabolism of the tissue and remove harmful metabolites. On the other hand, it can delay and reduce the degeneration of cartilage [66]. Its advantages lie in fundamentally blocking the pathological malignant circulation of KOA development, thereby achieving the purpose of eliminating the cause, relieving pain and restoring joint function. Passive movement of the knee joint can prevent joint damage and promote the regeneration of articular cartilage [67].

Professor Yan Juntao treats KOA with tuina manipulation based on the theory of Jinjing and distinguishes the disease stage with differentiation. He thinks that muscle paralysis is the core. Touching on the outside is a way to identify Jinjing syndromes [64]. Point, line, and surface are combined to characteristic treatment and Tuina manipulation. Gongfa can strengthen the function of Jinjing and the knee [65]. The law of manipulation is as follows: the main differentiation of the treatment is one-finger pushing, rolling, kneading the patellar, and often combined with rubbing, plucking, shaking, pulling, and rubbing. The core differentiation acupoints sites are: Dubi, Xiyan, Hedin, Yinlingquan, Yanglingquan, Xuehai, Zusanli, and baichongwo (**Figure 2**). If it is differentiated Foot-Yangming

Table 1. Advantages and disadvantages of diagnosis methods in knee osteoarthritis

Methods	Characteristic	Advantages	Disadvantages
Magnetic Resonance Imaging (MRI)	Digital image	Most commonly used, no radioactive hazards	Limited disease diagnosis, Long scanning time
Arthroscopic examination	Optical image	Small incision, little pain, quick postoperative recovery, less complications	Special instruments are complicated and expensive, Traumatic examination
High-frequency color ultrasound examination	Ultrasonography	On-invasive, fast, reasonable price	Short Detection distance
Thermal texture maps system (TIrM)	"Heat" phenomenon	High sensitivity, high specificity	Lack of precise anatomical positioning

Table 2. Advantages and disadvantages of treatment methods in knee osteoarthritis

Methods	Characteristic	Advantages	Disadvantages
Traditional medicine	Drugs	Auxiliary treatment method	Adverse reactions are difficult to control
Arthroscopic treatment	Optical image	Small incision, little pain, quick postoperative recovery, less complications	Special instruments are complicated and expensive, traumatic treatment
Surgical treatment	Integrated diagnosis and treatment	Good effect, low complication rate	High cost, traumatic treatment
Tuina manipulation therapy	Massage treatment	Painless, non-invasive and has a certain degree of comfort	Low penetration, few professionals

Jinjing (patellofemoral joint disease mainly), we usually use Biguan, Futu, Ashi (10 wer patellar tip, patellar week). If it is differentiated Foot-Shaoyang Jinjing (the lateral tibiofemoral joint disease mainly), we usually use Xiyangguan, Huantiao, Ashi (1ateral collateral ligament, the lateral joint space). Medial tibiofemoral joint disease mainly involves three Foot-yin Jinjings. As to Foot-Taiyang Jinjing, we usually use Heyang, Chengshan, Yinmen, Ashi (popliteal midpoint under). As to Foot-Taiyin Jinjing, we usually use Jimen, Ashi (goose foot, adductor tubercle, medial collateral ligament). As to Foot-Jueyin Jinjing, we usually use Ququan, Xiguan, Ashi (medial femoral condyle, medial gastrocnemius head). As to Foot-Shaoyin Jinjing, Yingu and Ashi (tibia medial rear) are usually used [66, 67].

Discussion

Knee osteoarthritis is a degenerative disease often encountered in clinical practice, and the majority of the patients with this disease are middle-aged. If it is not treated quickly and effectively, it can cause joint deformity and disability and lead to a series of complications. Severe cases can even limit patients' activities, which will have a greater impact on patients' quality of life. According to published studies, the occurrence of osteoarthritis in knee joints is usually caused by long-term labor, excessive weight, trauma, and cold [68]. With the continuous development of clinical research on knee osteoarthritis, the treatment plan for this condition has been effectively developed and applied, which has effectively promoted the further development of clinical work. However, it is undeniable that accurate clinical diagnosis is the key to achieving the desired effect of clinical treatment. Therefore, research on and applications of diagnostic methods have become an important part of clinical concern.

There are many treatments for KOA, but fundamentally these treatments are only remedial measures, and all treatments have limitations and deficiencies. There is currently no effective treatment that can prevent or reverse KOA completely. Researchers have not yet been able to develop effective drugs for the millions of KOA patients, mainly because the pathogenesis of the disease is not yet fully understood [69]. The extracellular matrix of chondrocytes in KOA patients is significantly reduced compared with normal patients. The degradation of the chondrocyte extracellular matrix could lead to the loss of cell survival and survival signals and cause the apoptosis of chondrocytes; matrix metalloproteinases and disintegrin metalloproteinases mediate the extracellular matrix. Degradation, dedifferentiation, and apoptosis of chondrocytes lead to the termination of the extracellular matrix synthesis, and this may be a landmark research target that can prevent the occurrence of KOA or treat KOA [70].

To sum up, we summarized the diagnosis and treatment methods of KOA. We simply described the advantages and disadvantages in **Tables 1** and **2**. In terms of diagnosis, high-frequency color ultrasound is one of the most commonly used methods for the diagnosis of

KOA. As a non-invasive, simple, and real-time detection method, high-frequency ultrasound has been widely used in the clinical diagnosis of KOA. It can clearly show the morphology and cartilage damage and subchondral articular surfaces, providing effective help for disease diagnosis, treatment, and prognosis. Arthroscopic treatment has the advantages of small incisions, a beautiful appearance, little pain, and rapid postoperative recovery. It can avoid long-term bedridden complications and does not substantially affect the muscle structure around the joints [68]. In the treatment aspect, the curative effect of tuina therapy on knee osteoarthritis is definite and has obvious advantages. Tuina manipulation is a therapy that is painless, non-invasive and has a certain degree of comfort. The application of tuina techniques to the knee joint can promote local muscle relaxation, enhance local blood circulation, and help promote the recovery of damaged tissue. The combination of Chinese and Western medicine for the treatment of KOA not only alleviates pain symptoms in the short term, but can also improve knee function in the mid to long-term and delay the KOA process. Although a single treatment drug is widely used to treat KOA and reduce joint swelling, it is prone to causing complications, and the treatment effect is slow. Besides, it can only relieve the pain and can only be used to help patients recover [69]. Although arthroscopic treatment techniques have the advantages of little trauma, mild postoperative pain and rapid functional recovery, they are still unsuitable for all patients with arthritis. They require high postoperative joint mobility, and only patients with low K-L grading have significant therapeutic effects. HTO, UKA and TKA show good clinical results and stable long-term efficacy during long-term follow-up. However, HTO, UKA and TKA have different indications. Age, body mass index, and the preoperative status of OA are all key factors influencing the occurrence of fatal complications after surgical treatment [71].

In short, knee osteoarthritis is a pathological process with a dynamic change. In clinical practice, the correct examination method should be selected according to the stage of disease development. In the course of treatment, "the theory of Jinjing and distinguishes the disease stage with differentiation" should be used to fully understand the importance of soft tissue around the knee joint [72]. In the near future, surgical KOA will be a thing of the past, but researchers still needed further research to prove the feasibility of this treatment concept.

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Disclosure of conflict of interest

None.

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