Gut Flora and Osteoarthritis and Improvement of Osteoarthritis Through Intake of Nutrients

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Abstract. Intestinal flora plays an important role in human health, and bone health is a topic of great concern. In recent years, researchers have begun to pay attention to the relationship between intestinal flora and osteoarthritis, attempting to use intestinal flora to promote bone health and lower the occurrence of osteoarthritis. Current studies have shown that the imbalance of intestinal flora may be associated with the onset and development of osteoarthritis, but the specific mechanism has not been fully elucidated. This article reviews some of the factors that contribute to the number of gut microbiota and how they contribute to osteoarthritis. It is concluded that the imbalance of intestinal flora may affect the condition of osteoarthritis. Due to the limited research at present, the mechanism of intestinal flora affecting bone and joint is not fully understood. This study provides a new perspective for understanding the pathogenesis of osteoarthritis, and future studies can further explore the influence of intestinal flora regulation on osteoarthritis and develop corresponding prevention and treatment strategies.

Keywords: Gut flora, osteoarthritis, intake of nutrients.

1. Introduction

The aging of the world's population is increasing, and bone-related diseases affect at least 25% of the global population, which is a worthy proportion, such as osteoarthritis, of which Osteoarthritis tends to occur in the middle-aged and elderly, and more than 50% of people over the age of 65 have the disease [1]. Osteoarthritis is a common chronic joint disease characterized by degeneration of the articular cartilage and inflammation of the tissues surrounding the joint. Common symptoms are joint pain, joint stiffness, joint swelling, joint deformation, and limited joint function. Medications such as non-steroidal anti-inflammatory drugs (NSAIDs) are currently available to relieve joint pain and inflammation. Physical therapy, including hot compresses, cold compresses, massage and rehabilitation exercises, can help reduce pain and improve joint range of motion and muscle strength. Although a variety of drugs have been developed to treat related diseases, the results are not satisfactory [2]. Therefore, improving people's quality of life, improving diet to achieve the purpose of prevention has become a popular treatment plan.

The gut microbiota, also known as the second brain, is closely related to people's health. Recent studies have shown that gut flora and their metabolites can act on Osteoarthritis in a variety of ways. Some of them play a role in regulating inflammation, metabolism, and many immune activities. Experts further classify the gut microbiota into probiotics, harmful bacteria, and conditional bacteria strains [3, 4]. Probiotics are beneficial to the human body and generally have a positive impact on the digestive system and overall health. Maintain the balance of intestinal flora, inhibit the growth of harmful bacteria, promote food digestion and nutrient absorption. Common probiotics are Lactobacillus, Lactococcus, Bacillus coagulans and so on. Harmful bacteria may have a negative impact on human health, such as causing infections or causing intestinal problems, disrupting the balance of intestinal flora, leading to intestinal problems, such as diarrhea, intestinal inflammation, etc. Some common harmful bacteria include E. coli, Salmonella, Shigella, etc. Conditional bacteria may have positive or negative effects on human health under certain conditions, depending on factors such as environmental factors and the body's immune status, and their effects may be more variable and uncertain. Some condition bacteria may be beneficial in a healthy state but may become harmful when the immune system is compromised or in other conditions. At the same time, the study also

suggests that a reasonably healthy diet and nutrition can help regulate the gut flora, which may have an impact on Osteoarthritis.

At present, the impact of intestinal flora on human health has received increasing attention, especially in the treatment of inflammatory diseases, such as oral supplementation of beneficial microorganisms or microbial metabolites in the form of oral preparations to regulate the balance of intestinal flora and reduce inflammatory response. The microbiome composition of the patient's gut is improved through fecal bacteria transplantation, thereby reducing the symptoms of inflammatory diseases. However, there is more research value in improving the intestinal flora to reduce the prevalence of bone and joint or improve osteoarthritis Therefore, this paper briefly describes the mechanism of intestinal flora affecting the Osteoarthritis and proposes to improve the level of bone health by improving nutrition.

2. Effects of Intestinal Flora on Osteoarthritis: an Animal Study

An experiment suggests that gut flora plays a role in traumatic osteoarthritis. In the experiment, the first group consisted of germ-free mice with osteoarthritis caused by medial meniscal instability surgery, and the second group consisted of normal mice with osteoarthritis [5]. The results showed that the severity of arthritis of the germ-free mice in the first group was significantly lower than that of the second group, indicating to some extent that the intestinal flora of the mice in the second group exacerbated the severity of bone and joint. This study suggests that intestinal flora has an effect on osteoarthritis. Follow-up studies have shown that gut flora can both relieve osteoarthritis and exacerbate bone joints. Perhaps too many or too few gut microbes can affect the severity of arthritis, and there is a balance, depending on the number and variety of gut flora. To a certain extent, gut microbes have a beneficial effect on arthritis. Conversely, it is possible that the immune regulation caused by gut microbes after injury may exacerbate joint inflammation [6].

The above animal experiments show that intestinal flora can affect osteoarthritis, and the research shows that the imbalance of intestinal flora is the key to the influence. This paper introduces this relationship in the following.

3. The Effect of Intestinal Microbial Imbalance on Joint

Gut microbiome dysregulation refers to a state characterized by changes in the diversity of the gut microbiome, encompassing the proliferation of pathogens, reduction of normal flora, and alterations in microbiome composition [7]. The gut microbiota is involved in various activities such as metabolism, inflammation, and autoimmunity.

3.1. Impact of Dysregulated Intestinal Flora on Osteoarthritis Pathogenesis

Dysregulation of intestinal flora has been associated with the pathogenesis of osteoarthritis, leading to impaired joint function. Experiments involving fecal microbial transplants from metabolically impaired patients exacerbated osteoarthritis severity in mice [8]. This suggests that the transplanted stool may have caused an imbalance in the number of intestinal bacteria in the mice, leading to an increase in the number of harmful bacteria or a decrease in the number of beneficial bacteria, which triggers inflammation and exacerbates the severity of osteoarthritis. Dysregulated gut microbes were also found to worsen cartilage and subchondral bone disease in mice with arthritis.

3.2. Antibiotic-induced Changes in Gut Microbes and Osteoarthritis

Experiments inducing changes in mouse intestinal flora through antibiotics demonstrated inhibition of associated inflammatory responses, thereby improving osteoarthritis. In one experiment, neomycin induced changes in the gut microbiota of mice. At the same time, the serum LPS level was also reduced [9], which inhibited the inflammatory response and reduced the severity of osteoarthritis. This suggests that antibiotics have the ability to alter gut microbiota, which more research is needed

to explore. A conclusion can be drawn by combining 2.1 and 2.1 that alterations in gut microbiome composition can both promote and inhibit inflammatory responses, impacting osteoarthritis severity and cartilage damage, it depends on which microbial populations and species are changed.

3.3. Age-related Changes in Gut Microbiome and Osteoarthritis

Prevalence Specific changes in gut microbiome composition in the elderly were linked to osteoarthritis prevalence [10]. Studies have found that in older people that an increase in opportunistic pro-inflammatory bacteria, a decrease in symbiotic anti-inflammatory bacteria [11], were identified as factors influencing inflammatory disease occurrence and persistence.

3.4. Changes in intestinal permeability can affect the intestinal flora

Development Increased intestinal barrier permeability, associated with dysregulation of the gut microbiota, was positively correlated with osteoarthritis severity in mice. When the intestinal barrier is broken, it will greatly increase the chance of harmful bacteria entering the intestine, the body will activate mucosal inflammation, and the overall show a pro-inflammatory state [9], thereby causing and worsening osteoarthritis. Inside the gut, the intestinal flora can produce lipopolysaccharides, which use changes in permeability to transfer lipopolysaccharides to the circulatory system, causing mild inflammation.

4. The Effect of Probiotics on Joints

By preventing the production of pro-inflammatory cytokines and cartilage degradation, the probiotic complex prevented the development of osteoarthritis in a rat model of the disease. In a human study, more than five hundred osteoarthritis patients were randomized to receive a placebo or L. casei, and after six months, there was a substantial decrease in systemic inflammation in the experimental group as compared to the control group [12]. The degradation of osteoarthritis is lessened when Streptococcus thermophilus is administered orally. Oral administration of Clostridium butyrate has been shown to drastically reduce the quantity of fibrous tissue, protect the knee cartilage and synovium in osteoarthritis rats, and lower serum concentrations of numerous inflammatory and metabolic markers of bone and cartilage. Lactic acid bacteria reduce proinflammatory cytokines, which in turn reduces arthritic damage.

Probiotics have just been introduced to the list of medications used to treat arthritis [13]. because studies on arthritic rats have demonstrated that L. casei inhibits joint swelling, lowers rheumatoid arthritis, and prevents bone degeneration [14]. In addition, lactobacillus acidophilus cases are frequently utilized as medications to treat rheumatoid arthritis. Probiotics appear to have flora-specific effects on rheumatoid arthritis, and there is still some evidence that they can potentially improve the outcomes associated with the disease.

Short-chain fatty acids modulate the amount of IL-10 released by regulatory T cells, thereby mitigating the severity of arthritis [15]. Because Lactobacillus acidophilus produces butyric acid, it reduces osteoarthritis by regulating chondrocyte autophagy and inflammatory cell death. Butyric acid generated from probiotics has been demonstrated to prevent arthritis in mice by influencing the development of T and B cells.

The results of the current study on probiotics and their secondary metabolites are scarce. Its immunomodulatory and anti-inflammatory qualities, however, call for more research to understand its function and molecular mechanisms within the musculoskeletal system.

5. The Effects of Some Nutrients on the Intestinal System

Osteoarthritis as A disease of the skeletal system is associated with many nutrients such as prebiotics, vitamin D, vitamin A, and calcium [16]. The effects of osteoarthritis can be reduced by supplementing the relevant nutrients to improve the skeletal system by acting on the gut flora.

Prebiotics are an indigestible dietary fiber that selectively stimulates or promotes the growth of specific strains of gut microorganisms, leading to advantageous physiological effects. Prebiotic supplements have been demonstrated to support beneficial skeletal muscle alterations, including decreased levels of endotoxins in circulation, decreased inflammation, and increased muscle mass. In addition, prebiotics promote the production of short-chain fatty acids, which further regulates the immune system and intestinal health.

Vitamin D is essential for increasing bone density [17], not only having a direct impact on calcium absorption but also controlling intestinal mucosal homeostasis through intestinal mucosa integrity, which influences the immune system's performance and the body's inflammatory response. Supplementing with vitamin D promotes the diversity and regulation of gut flora, which helps to improve illnesses like osteoarthritis.

Similar functions of vitamin A include preserving bacterial diversity, controlling immunological response, and preserving intestinal barrier function, all of which contribute to intestinal homeostasis. However, more experimental evidence on the role of vitamin D in improving muscle mass is needed to strengthen the conclusions of clinical trials.

One of the most prevalent minerals in the human body is calcium, and the proper growth of bones is directly correlated with calcium consumption [18]. Maintaining the proper excitatory and contractile function of skeletal muscles requires calcium, and consuming enough of it through diet can also alter and improve the variety of the gut flora. By improving the absorption of calcium from the diet, calcium also has a protective effect on the intestinal barrier, which enhances bone density.

In summary, prebiotics, vitamin D, vitamin A, and calcium play an important role in musculoskeletal system health. However, more experimental evidence on the role of vitamin D in improving muscle mass in the elderly population is still needed to strengthen the conclusions of clinical trials.

6. Conclusion

The study of the connection between gut flora and bone and joint health has advanced significantly in recent years. This study examined the connection between intestinal flora and osteoarthritis, concluding that an imbalance in intestinal flora would have an impact on the bone and joint. At the same time, the influence of age, antibiotics and changes in intestinal permeability on the number of flora and some mechanisms were described. Various factors in life, such as nutrient intake and age, will change intestinal flora to varying degrees, thus affecting the occurrence of inflammation. People can prevent osteoarthritis by improving nutrition as much as possible. As mentioned in the article, people can strengthen their intake of vitamin D, vitamin A, and calcium, reduce their intake of high fat, and improve their living habits. Avoiding prolonged sitting and exercising can greatly improve the status of osteoarthritis. The gut microbiota itself is a huge field, and there are still many gaps in the current research. At present, more efforts are needed for the treatment of osteoarthritis. Although studies have shown that gut microbiota can influence osteoarthritis, the specific mechanisms of action have not been fully elucidated. For example, through what pathway the gut flora affect the development of osteoarthritis, and which specific flora have a more significant impact on it? This is also a limitation of this paper, which does not elaborate on how specific bacteria act on osteoarthritis, and future studies can be more specific, focusing on the impact of specific bacteria on osteoarthritis. Prevention and treatment strategies for this association are still relatively lacking, and effective interventions need to be further developed and validated. By filling in these study gaps, we can gain a better knowledge of the connection between osteoarthritis and gut microbiota, which will enable us to develop more focused preventative and treatment strategies in the future.

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