Dean&Francis
ISSN 2959-409X

Rehabilitation treatment strategies for rheumatoid arthritis

Xi Li

Ulink College of Shanghai, Shanghai, 201108, China
Xi.Li@ulink.cn

Abstract:

Rheumatoid arthritis (RA) is a common chronic autoimmune disease, with a global incidence rate of 0.5%-1.0%. The disease is mainly characterized by morning stiffness, swelling, deformation, and pain of the joints, which significantly impairs patients' quality of life. Currently, clinical treatment for the active phase of RA primarily relies on medications and surgery. While these approaches can alleviate inflammation and pain, they are prone to causing side effects such as liver function damage and gastrointestinal reactions. Therefore, rehabilitation therapy has become a key method to compensate for the limitations of medications and improve patients' functional abilities. This paper reviews three types of rehabilitation methods. Occupational therapy, cryotherapy, and orthotic rehabilitation engineering. In occupational therapy, individualized exercise programs, task-oriented training, and digital tools can improve patients' functions; however, the combined benefits of compensatory interventions and exercise training remain controversial. Cryotherapy can relieve symptoms, and cold air plasma can further inhibit synovial hyperplasia. Orthotics can improve joint function, and technologies such as 3D printing have facilitated the personalized development of orthotics. In the future, efforts should be made to strengthen interdisciplinary collaboration, explore combined therapies, establish standardized evaluation systems, and conduct large-sample long-term studies.

Keywords: Rheumatoid arthritis, occupational therapy, physical therapy, rehabilitation engineering

1. Introduction

Rheumatoid arthritis (RA) is a common chronic autoimmune disease, with a global incidence rate of 0.5%-1.0%. The incidence rate in China is 0.42%, and the number of domestic patients is approximately 5 million [1]. RA causes morning stiffness, swelling, deformation, redness, and pain in joints. The most commonly affected sites include the wrists, palms, and fingers. In severe cases, RA can affect

other body systems such as the respiratory and cardiovascular systems. The exact cause of RA remains unclear, but it may be related to the immune system mistakenly attacking normal tissues, genetic factors leading to susceptibility, and environmental factors. The active phase is a critical stage of the disease, during which patients experience active inflammation and worsening symptoms, manifested as unbearable pain and severe joint deformation. Controlling and reducing the impact of active-phase symptoms plays a significant role in slowing disease progression [2]. Currently, the treatment of active RA mainly relies on medications to reduce inflammation and pain. Commonly used clinical drugs include non-steroidal anti-inflammatory drugs (NSAIDs), disease-modifying antirheumatic drugs (DMARDs), steroids, and biological antibody drugs. In addition, for severe bone defects faced by patients with advanced RA, 3D-printed porous metal prostheses (such as tantalum and titanium alloys) are used in joint replacement surgery. These prostheses can fill large bone gaps, significantly improve prosthesis stability, and are particularly suitable for reconstructing large bone defects in RA knee revision surgery, effectively promoting post-operative functional recovery. Such new materials can also achieve a high degree of personalization through design matching, perfectly fitting the patient's bones [3]. In recent years, multiple studies have pointed out that the aforementioned clinical drugs can cause side effects such as liver function damage and gastrointestinal reactions. Therefore, it is necessary to combine rehabilitation treatment to make up for the shortcomings of drug treatment. Rehabilitation treatment mainly includes occupational therapy, physical therapy, and rehabilitation engineering, which are used to help restore joint function and muscle strength, as well as reduce pain. This article will review the above three rehabilitation treatment methods developed in recent years.

2. Occupational Therapy(OT)

RA leads to chronic, progressive joint degeneration in patients, which in turn causes joint deformity and decreased grip strength, seriously affecting daily life. Occupational therapy aims to help patients restore or improve their ability to perform daily living activities, work, and social interactions through training, adaptive strategies, and assistive devices. The core concept of occupational therapy is to help patients adapt to disabilities and improve independence. Occupational therapy can be divided into two categories: compensatory intervention and exercise training. Compensatory intervention helps patients bypass functional impairments and maintain daily living ability through adaptive strategies (such as assistive devices, environmental modifications, and behavioral adjustments). Exercise training is an important part of function-oriented intervention in OT, which directly improves physical function through active training (such as muscle strength and joint range of motion exercises).

A randomized controlled trial (SARAH trial) involving 490 RA patients showed that adding an individualized hand exercise program (strengthening + stretching) to routine care significantly improved patients' Michigan Hand Outcomes Questionnaire (MHQ) scores after 12 months (mean difference 4.4 points, $P<0.05$) and was cost-effective (incremental cost-effectiveness ratio £17,941/QALY) [4]. This indicates that OT combined with exercise intervention has long-term clinical value. A study by Özcelep ÖF et al. showed that the experimental group, which combined 5 weeks of task-oriented training (TOT) with routine exercise, significantly reduced Health Assessment Questionnaire (HAQ) and Disabilities of the Hand, Arm and Shoulder (DHI) scores ($P<0.05$), confirming that hand occupational therapy significantly improves activities of daily living (ADL) [5].

With the development of technology, digital OT tools provide convenient rehabilitation support for RA patients. For example, a treatment course designed for 36 patients with hand rheumatoid diseases through the mobile app Carehand showed that through customized exercise programs and self-management and monitoring tools, overall hand function, work performance, pain levels, and satisfaction all improved significantly (all $P<0.05$) [6]. This model breaks the geographical limitations of traditional OT, but it should be noted that secondary outcomes (such as grip strength) did not show significant differences, which suggested that technical interventions still need further optimization.

Although both compensatory strategies (such as the use of assistive devices) and exercise training in OT have been proven effective, whether their combination has additive benefits remains controversial. A study on 55 female RA patients [7] compared the effects of "compensatory intervention program (CIP) + hand exercises" with CIP alone. It was found that there was no significant difference in the improvement of observational ADL ability (Assessment of Motor and Process Skills, AMPS scores) between the two groups ($P=0.88$), and approximately 45% of patients achieved clinically relevant improvements. This may suggest that for some patients, compensatory strategies are sufficient to meet ADL needs, and the additional benefits of exercise require individualized evaluation.

3. Physical Therapy - Cryotherapy

In the acute active phase of RA, cryotherapy can be used

ISSN 2959-409X

as a physical therapy method. Cryotherapy involves applying physical agents (such as cold water, ice cubes) with temperatures lower than human body temperature to stimulate the body for disease treatment. The therapeutic effects of cryotherapy include reducing acute inflammatory responses and relieving pain. Cryotherapy causes peripheral vasoconstriction, reduces blood supply, and blocks histamine release, thereby slowing blood circulation and local metabolism, which is beneficial for inhibiting inflammatory responses [8]. Cryotherapy also reduces muscle spasms by lowering nerve conduction, thereby achieving pain relief.

A non-randomized controlled trial found that both -30℃ cold air therapy and ice massage significantly relieved hand pain in patients with active RA, and the analgesic effect lasted for more than 60 minutes. However, there was no significant difference in the improvement of grip strength between the two methods. This indicates that the short-term effect of cryotherapy focuses more on symptom control rather than fundamental changes in disease activity [9]. In addition, Peres et al. (2021) found that combining 15℃ cold water therapy after exercise can reduce heart rate and pulse wave velocity in RA patients, suggesting that cryotherapy may reduce vascular inflammatory responses by regulating autonomic nervous function [10].

It is worth noting that the therapeutic effect of cryotherapy on RA is not limited to symptom relief; it may also interfere with the core pathological link of the disease—synovial hyperplasia. Rheumatoid arthritis fibroblast-like synoviocytes (RA-FLS) share similarities with cancer cells. The abnormal proliferation and anti-apoptotic properties of synovial fibroblasts are key factors leading to joint destruction. Recent studies have found that cold atmospheric plasma (CAP) can specifically activate the mitochondrial apoptotic pathway of RA-FLS through the production of reactive oxygen species (ROS) cascades. A series of studies by Ding et al. confirmed that in RA model animals treated with CAP, hyperplasia, angiogenesis, and inflammation in synovial tissue were significantly reduced. The mechanism involves the activation of the ROS-ASK1-p38 signaling axis triggered by CAP, which further upregulates the expression of caspases 3/7 and promotes programmed cell death of RA-FLS. This effect can induce apoptosis while preserving the self-antioxidant capacity of surrounding normal tissues, reflecting the unique advantage of CAP as a targeted physical therapy [11]. Bioinformatics analysis further revealed that CAP can reconstruct the imbalanced redox state in local synovium by regulating key pathways of oxidative stress responses (such as the NADPH oxidase system), which explains the effectiveness of cryotherapy on pathological cells at the molecular level. Therefore, the chemical effects (rather than physical effects) produced by CAP, as well as its regulation of oxidative stress responses and anti-tumor cell properties, are expected to become a means to inhibit RA-FLS activation and synovial hyperplasia.

Compared with traditional systemic drugs, CAP acts directly on the diseased synovium in the joint cavity through a local minimally invasive method, avoiding systemic side effects such as osteoporosis and infection caused by glucocorticoids or immunosuppressants [8]. Especially for patients with refractory RA who have poor drug responses, this local physical intervention may become a supplementary treatment option. Future research directions should include optimizing equipment design, exploring combined medication strategies, and developing individualized treatment plans.

4. Rehabilitation Engineering - Orthoses

RA causes structural changes in the wrist and hand joints of patients. Pathological changes such as ulnar deviation deformity and boutonniere deformity seriously affect patients' daily activities. Clinical studies have shown that fitting upper limb orthoses can effectively relieve symptoms and improve function. Silva et al. (2008) conducted a randomized controlled trial involving 40 RA patients with thumb boutonniere deformity [12]. The results showed that compared with the control group, patients in the experimental group who wore functional thumb orthoses for a long time had significantly relieved pain, and their hand grip strength increased by 20%-30%. In addition, the application of pressure gloves also showed good clinical effects. Through uniform pressure distribution, pressure gloves effectively control hand joint swelling and reduce pain symptoms. These studies provide a solid medical basis for the application of upper limb orthoses in RA treatment.

As weight-bearing joints, the foot and ankle joints are prone to deformation during the course of RA, manifested as forefoot pain, arch collapse, and gait abnormalities. Customized foot orthoses (FO) improve pain relief and function by optimizing plantar pressure distribution and correcting abnormal biomechanical alignment. Gibson et al. used digital technology to design two types of functionally optimized orthoses, namely selective laser sintering (SLS) and fused deposition modeling (FDM) [13]. The study found that SLS orthoses performed well in reducing peak hindfoot movement ($P<0.0001$) and decreasing metatarsal area pressure ($P=0.018$-0.022), while significantly improving patients' wearing comfort.

Guidelines for RA foot and ankle treatment suggest that customized FOs have significant benefits in reducing foot pain, enhancing joint function, and improving quality of life. Therapeutic shoes, due to their wide toe boxes and cushioning design, are also regarded as the core option for conservative treatment [8].

RA patients often have comorbid sarcopenia, which further aggravates functional impairment, and orthoses are an effective intervention for sarcopenia. Hishikawa et al. conducted a 6-month FO intervention on 15 RA patients with foot impairment and comorbid sarcopenia. They found that orthoses not only reduced foot pain during walking (P=0.01-0.04) but also significantly improved quality of life (QOL) by increasing low-intensity activities (such as slow walking), especially in the "pain and daily function" dimension (P=0.02-0.04) [14]. This result suggests that orthoses not only have a direct biomechanical intervention effect but may also indirectly delay the progression of muscle atrophy by improving activity ability. However, the effect of orthoses on high-intensity activities still requires more research verification.

Although orthoses have achieved significant results in RA treatment, there are still several problems to be solved. For example, most existing studies are limited to short-term efficacy observation and lack long-term follow-up data. Currently, there is a lack of direct comparison between different types of orthoses. Future research on orthoses will focus on the development of new-generation personalized orthoses using new technologies such as 3D printing and intelligent sensing. Clinical research should focus on conducting large-sample long-term follow-up studies and randomized controlled trials, and establishing evidence-based clinical application guidelines for orthoses to better guide the clinical application of orthoses in RA treatment.

5. Conclusion

In summary, RA is a chronic immune system disease mainly characterized by joint damage and potentially accompanied by multi-system impairment. Its core treatment methods are drug therapy and surgery, which control inflammation and relieve symptoms from the internal biological and histological levels. Rehabilitation treatment mainly focuses on the external biomechanical and functional levels, aiming to reduce joint damage and pain caused by the disease. This article mainly discusses occupational therapy focusing on compensatory intervention and exercise training, physical therapy focusing on cryotherapy, and rehabilitation engineering therapy focusing on orthoses. Although rehabilitation treatment has been proven effective in improving the quality of life of RA patients through a large number of experiments, current research still has some shortcomings. For example, most current studies only evaluate the effectiveness of one treatment method and do not design combined experiments for comparison. Whether combining OT with DMARDs is effective for disease treatment remains unclear. The accumulation and evaluation of long-term efficacy data are also insufficient. Future research directions should focus on enhancing interdisciplinary collaboration including cooperation between physicians, physical therapists, occupational therapists, and nurses, to jointly explore more possible combined therapies. At the same time, a standardized evaluation system should be established to track the rehabilitation treatment of RA patients in the long term, so as to provide more effective rehabilitation treatment for RA patients.

References

[1] Wan Yakun, Liu Yuan, Qu Yuan, et al. Application and Progress of Rehabilitation Therapy in the Active Phase of Rheumatoid Arthritis. Rehabilitation Medicine, 2025, 35(1): 96-104.

[2] Rao Huiling, Wang Hongning, Wang Kailing, et al. Research progress on rehabilitation functional exercise for patients with rheumatoid arthritis. Journal of Nurses Training, 2019, 34(9): 795-798.

[3] Xu Ying, Guo Aisong. Recent status of rehabilitation assessment and treatment for rheumatoid arthritis. Rheumatism and Arthritis, 2023, 12(9): 61-65.

[4] Williams M A, Williamson E M, Heine P J, et al. Strengthening And stretching for Rheumatoid Arthritis of the Hand (SARAH). A randomised controlled trial and economic evaluation. Health Technology Assessment, 2015, 19(19): 1-222.

[5] Özcelep Ö F, Üstün I. Effect of task-oriented training on pain, functionality, and quality of life in rheumatoid arthritis. Turkish Journal of Physical Medicine and Rehabilitation, 2022, 68(1): 76-83.

[6] Rodríguez Sánchez-Laulhé P, Luque-Romero L G, Barrero-García F J, et al. An Exercise and Educational and Self-management Program Delivered with a Smartphone App (CareHand) in Adults With Rheumatoid Arthritis of the Hands: Randomized Controlled Trial. JMIR mHealth and uHealth, 2022, 10(4): e35462.

[7] Ellegaard K, von Bülow C, Røpke A, et al. Hand exercise for women with rheumatoid arthritis and decreased hand function: an exploratory randomized controlled trial. Arthritis Research & Therapy, 2019, 21(1): 158.

[8] Zhu Lixin, Mei Jing, Zeng Guoji, et al. Research Progress on Rehabilitation Treatment Strategies for Patients with Rheumatoid Arthritis. Traditional Chinese Medicine Rehabilitation, 2025, 2(8): 50-55.

ISSN 2959-409X

[9] Laktašić Žerjavić N, Hrkić E, Žagar I, et al. Local Cryotherapy, Comparison of Cold Air and Ice Massage on Pain and Handgrip Strength in Patients with Rheumatoid Arthritis. Psychiatria Danubina, 2021, 33(Suppl 4): 757-761.

[10] Peres D, Prati C, Mourot L, et al. Effects of an Exercise Program and Cold-Water Immersion Recovery in Patients with Rheumatoid Arthritis (RA): Feasibility Study. International Journal of Environmental Research and Public Health, 2023, 20(12): 6128.

[11] Ding C, Liu Q, Ouyang W, et al. Cold atmospheric pressure plasma: A potential physical therapy for rheumatoid arthritis hyperplastic synovium. International Immunopharmacology, 2023, 123: 110732.

[12] Silva P G, Lombardi I Jr, Breitschwerdt C, et al. Functional thumb orthosis for type I and II boutonniere deformity on the dominant hand in patients with rheumatoid arthritis: a randomized controlled study. Clinical Rehabilitation, 2008, 22(8): 684-689.

[13] Gibson K S, Woodburn J, Porter D, et al. Functionally optimized orthoses for early rheumatoid arthritis foot disease: a study of mechanisms and patient experience. Arthritis Care & Research, 2014, 66(10): 1456-1464.

[14] Hishikawa N, Toyama S, Sawada K, et al. Effect of Foot Orthosis Treatment on Quality of Life in Secondary Sarcopenia Patients with Rheumatoid Arthritis-Related Foot Impairment. Progress in Rehabilitation Medicine, 2022, 7: 20220047.