Progress in the Application of Gait Analysis in Orthopedics and Physical Rehabilitation

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Abstract: Human walking function is the biggest characteristic that distinguishes other animals, and it needs the coordination of multiple parts of the body to complete the movement.Gait analysis is a new method to study walking function and state, and it is also a hot topic of medical researchers and medical workers in orthopedics, physical rehabilitation and other fields in recent years.After hundreds of years of development, the medical field has realized the accurate and objective measurement of gait, and developed a variety of gait analysis systems suitable for different needs, such as plantar pressure measurement system, unmarked gait analysis system, wearable sensor system, etc.In the context of the continuous progress of related hardware and software technology, the scope of application of gait analysis is also gradually expanding. This paper mainly combined with the research situation of gait analysis in orthopedics and physical rehabilitation in recent years, to review the new progress of related research.

Keywords: Gait Analysis; Orthopedics; Physical Rehabilitation; Application Progress

Introduction

Gait analysis is a hot research topic in the medical field in recent years. It belongs to the research direction of biomechanics. The research content covers human walking function and walking state, involving multidisciplinary knowledge of physiology, anatomy, mechanics, etc[1]. Gait analysis research has a long history, dating back to the early 17th century. At that time, some researchers proposed to apply the principles of geometry, mechanics and other disciplines to the study of the movement rules of the skeletal musculoskeletal system under human activities, laying the foundation for gait analysis research [2]. In the application of gait analysis, it is necessary to compare with the normal data to clarify the abnormal parameters of the intervention objects and the relevant change rules, so as to realize the precise and individualized analysis of the factors affecting gait, and provide strong support for clinical disease assessment, disease diagnosis, treatment decision, etc.[3] [4]. In the field of orthopedics and physical rehabilitation, the traditional diagnosis and evaluation of diseases depends on the judgment of specialists on gait characterization, symptoms and signs, and chief complaints, and auxiliary laboratory and imaging examination for diagnosis. In terms of objective assessment, there is a lack of precision and sensitivity indicators. However, the research and application of gait analysis can effectively get rid of the above predicament.To provide sensitivity index in objective evaluation, diagnosis and prognosis of disease.This paper summarizes the progress of clinical research and application of gait analysis in orthopedics and physical rehabilitation in recent years, as

follows.

1. Basic concepts and methods of gait analysis

1.1 Basic concepts of gait analysis

Gait analysis refers to the analysis of human gait. From A medical point of view, human gait can be divided into normal gait and abnormal gait, among which normal gait is the most natural walking gait that conforms to human characteristics and comfort level. Walking with normal gait can maintain proper length of steps and body stability[5]. Abnormal gait will show abnormalities from the changes in body stability, different step length, abnormal increase in energy consumption and other aspects during walking. The generation of abnormal gait is mainly related to the pathological changes in a certain part of the body and the changes in health degree and other factors, mainly involving the peripheral nervous system, central nervous system, skeletal muscle system and other systems and corresponding organs and tissues.For example, common arthritis, fracture and pelvic injury can lead to abnormal gait [6]. Gait analysis in the medical field is mainly through the application of multidisciplinary principle knowledge for abnormal gait analysis, through the acquisition of gait parameters to identify problems and analyze the reasons.A complete gait cycle involves support phase and swing phase, both of which are in a normal equilibrium state to ensure normal gait [7]. At present, various gait analysis systems can be applied to different scenes to meet different needs. The acquisition of gait parameters such as gait cycle, dynamic parameters and kinematic parameters is the basis of the gait analysis system, such as recording step size, gait cycle and large joint motion Angle. Through the acquisition and measurement of various parameters, precise parameters are provided for the evaluation of abnormal gait.

1.2 Gait analysis Method

Gait analysis methods are varied, including footprint method, three-dimensional dynamic analysis, visual gait analysis, etc. Different methods have different application scenarios and characteristics [8] [9]. Foot printing method is widely used, with advantages of simple operation and low price. After evenly applying dye to the sole of the tested person, the foot is naturally walked on the hard ground laid with extension paper, and the data such as step length and width are recorded. In the three-dimensional dynamic analysis, the quantitative analysis of walking rules using three-dimensional space can obtain parameters such as range of motion, speed and displacement, and realize the acquisition of biomechanical information of key muscle tissues during walking, which has high accuracy and objectivity, and the application scenario is much higher than that of footprinting method.Visual gait analysis method is to record and observe gait features by using camera technology. Compared with three-dimensional dynamic analysis, visual gait analysis method has higher professional requirements for the tester, and has certain empirical and subjective characteristics. It is mostly used for auxiliary diagnosis in clinical diagnosis and treatment, with high limitations.

2. Application of gait analysis in orthopedics

Fracture is the most common type of disease in orthopedic diagnosis and treatment, such as calcaneal fracture, hip fracture, etc., mostly caused by various accidents, clinical treatment for all kinds of fracture mainly to fracture reduction, external fixation, internal fixation, mainly divided into two categories of surgical treatment, conservative intervention, no matter what kind of treatment, the occurrence of dysfunction is the majority of patients faced with common problems,It can directly affect patients' motor function and reduce their quality of life.The application of gait analysis can effectively make up for the shortcomings of traditional imaging examination and laboratory examination, and provide objective and quantitative indicators for rehabilitation intervention.Foot pressure gait analysis system can obtain the pressure between the foot and the ground of fracture patients in walking, standing and other activities through computer technology. Domestic

doctors[10] applied this system to patients with calcaneal fracture. Through foot pressure analysis to clarify the focus of rehabilitation treatment and develop rehabilitation training plan in line with individual needs, compared with the traditional rehabilitation training found that the application of foot pressure gait analysis system can promote the improvement of motor function of fracture patients, help patients to return to normal life as soon as possible. In A related foreign study [11], gait analysis was applied to fracture patients, and plantar stress measurement was carried out on selected cases of intertrochanteric fracture of femur, showing that the application of this test can effectively evaluate the application advantages of different operations in postoperative rehabilitation.To provide reference for the development of clinical treatment.

3. Application of gait analysis in the field of physical rehabilitation

In recent years, rehabilitation medicine is one of the disciplines with rapid development, and physical rehabilitation is an important branch of it. Gait analysis plays an irreplaceable value in the field of physical rehabilitation, and the diversification of application value is its important characteristic. For example, gait analysis can be applied to the quantitative assessment of limb function, provide precise reference basis for the formulation of diagnosis, treatment and rehabilitation programs, evaluate the comfort and effectiveness of the application of treatment methods, and evaluate the effects of diagnosis, treatment and rehabilitation interventions [12]. Foreign doctors [13] analyzed the advantages of physical rehabilitation therapy in improving the results of gait analysis based on the data of some patients after horseshoe varus, and compared it with Ponseti method.The results show that the application of physical rehabilitation therapy can effectively avoid the situation of excessive correction, but there is a certain risk of deformity, so it is necessary to combine the actual situation of patients to choose the treatment method.Hemiplegia after stroke is a key lesion type in the field of physical rehabilitation. Affected by the high incidence of chronic diseases, the incidence base of hemiplegia cases is increasing globally, and related rehabilitation work has also become the focus of research in the field of physical rehabilitation.The measurement and acquisition of motion parameters, dynamic parameters, and electromyographic activity parameters in gait analysis can realize the individualized formulation of rehabilitation treatment programs. Meanwhile, gait analysis in the rehabilitation intervention process can help doctors timely grasp the mechanism of gait abnormality[14] .Adjust the rehabilitation program in time to ensure the rehabilitation effect.

4. Summary and Outlook

At present, with the rapid development of medicine, gait analysis technology is also constantly innovative, and its application in various clinical fields is gradually expanded. In the context of the development of precision medicine, gait analysis has irreplaceable value.In recent years, our country vigorously developed gait analysis technology. Some medical institutions and scientific research institutions introduced gait analysis system, which laid the better foundation for related scientific research.At present, the application of gait analysis technology in China is still in the early stage, with great progress and exploration space, and the research of related technology is expected to provide more favorable support for the development of orthopedics and physical rehabilitation related diagnosis and treatment work.

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