SPORTS INJURIES IN HIGH-LEVEL AEROBIC GYMNASTICS ATHLETES

LESÕES ESPORTIVAS EM ATLETAS DE GINÁSTICA AERÓBICA DE ALTO NÍVEL

LESIONES DEPORTIVAS EN ATLETAS DE GIMNASIA AERÓBICA DE ALTO NIVEL

ORIGINAL ARTICLE
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ABSTRACT

Introduction: With the rapid development of aerobic gymnastics worldwide, research is required to constantly increase. Objective: Analyze the main causes of sports injuries, proposing measures for prevention, treatment, and rehabilitation, as well as providing a theoretical basis for reducing the risk of sports injuries and actively seeking ways and measures to prevent and treat sports injuries in aerobic gymnastics athletes. Methods: Statistical-mathematical analysis was used, mainly including the coefficient of variation method, correlation matrix method, and factor analysis. The common variable of the trend of sports injuries was found. Results: The research shows that the scientific awareness, self-protection, and injury prevention of aerobic gymnastics training strengthen the ideological education and theoretical guidance of athletes, improve athletes' awareness of sports injuries, regulate technical specifications, strengthen fitness training and improve Chinese competitive aerobics. Conclusion: In the healthy period before injuries, we should take various measures to improve physical fitness and skills, enabling good health work in the acute period after injuries and understanding the working principle of early diagnosis and treatment to better use treatment time. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Statistical Inference; Athletes; Athletic Injuries.

RESUMO

Introdução: Com o rápido desenvolvimento da ginástica aeróbica no mundo, é requisitado o aumento no nível das pesquisas constantemente. Objeto: Analisar as principais causas de lesões esportivas, propondo medidas de prevenção, tratamento e reabilitação, além de fornecer uma base teórica para reduzir o risco de lesões esportivas e buscar ativamente formas e medidas para prevenir e tratar lesões esportivas em atletas de ginástica aeróbica. Métodos: Foi utilizada uma análise estatística-matemática, principalmente incluindo o método de coeficiente de variação, método de matriz de correlação e análise de fatores. Encontrou-se a variável comum da tendência das lesões esportivas. Resultados: A pesquisa mostra que a consciência científica, autoproteção e prevenção de lesões dos métodos de treinamento de ginástica aeróbica fortalece a educação ideológica e a orientação teórica dos atletas, melhora a consciência dos atletas sobre lesões esportivas, regula especificações técnicas, fortalece o treinamento de aptidão física e melhora a aeróbica competitiva chinesa. Conclusão: No período saudável antes das lesões, devemos tomar várias medidas para aprimorar a aptidão física e as habilidades, permitindo um bom trabalho de saúde no período agudo após as lesões, compreendendo o princípio de trabalho de diagnóstico e tratamento precoces para aproveitar melhor o tempo de tratamento. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

***Descritores*:** *Inferência Estatística; Atletas; Traumatismos em Atletas.*

RESUMEN

Introducción: Con el rápido desarrollo de la gimnasia aeróbica en el mundo, es necesario aumentar constantemente el nivel de investigación. Objetivo: Analizar las principales causas de las lesiones deportivas, proponiendo medidas de prevención, tratamiento y rehabilitación, así como proporcionar una base teórica para reducir el riesgo de lesiones deportivas y buscar activamente formas y medidas para prevenir y tratar las lesiones deportivas en los deportistas de gimnasia aeróbica. Métodos: Se utilizó el análisis estadístico-matemático, que incluye principalmente el método del coeficiente de variación, el método de la matriz de correlación y el análisis factorial. Se encontró la variable común de la tendencia de las lesiones deportivas. Resultados: La investigación muestra que la concienciación científica, la autoprotección y la prevención de lesiones de los métodos de entrenamiento de la gimnasia aeróbica refuerzan la educación ideológica y la orientación teórica de los atletas, mejoran la concienciación de los atletas sobre las lesiones deportivas, regulan las especificaciones técnicas, refuerzan el entrenamiento físico y mejoran el aeróbic de competición chino. Conclusión: En el período de salud antes de la lesión, debemos tomar varias medidas para mejorar la aptitud física y las habilidades, lo que permite un buen trabajo de salud en el período agudo después de la lesión, la comprensión del principio de trabajo de diagnóstico y tratamiento temprano para hacer un mejor uso del tiempo de tratamiento. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

***Descriptores*:** *Inferencia Estadística; Atletas; Traumatismos en Atletas.*

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INTRODUCTION

Bodybuilding operation is a mass sport, only competition can make it a real sport. Competitive calisthenics is becoming more and more difficult, comprehensive and intensive, and the incidence of sports injuries in training and competition is also increasing[1,2]. The occurrence of sports injury will destroy the system of sports training and affect the improvement of training and competition results[3,4]. When athletes go through the process of recovery from injury and return to training, they often have certain cognitive and emotional reactions, which are mainly affected by personal and environmental factors. Competitive aerobics is the main purpose of winning the championship[5,6]. The athletic aerobics athletes must meet the technical requirements of the rules specified in the rules when completing the set of movements. The difficulty of the action is not well controlled, etc[7-10]. The knee joint is damaged. Therefore, the composition and movement of each movement of the aerobics must be smooth, natural and reasonable. The route and displacement of the movement should be reasonable[11,12]. Converted to principle. In addition, the time of injury will also affect the psychology of the injured athlete. High-level athletes naturally become the all-round performers of the competitive aerobics competition rules. The self-action innovation of high-level athletes also promotes the further evolution of the competition rules. The two complement each other and jointly promote the development of competitive aerobics[13,14].

As we all know, the training of high-level Competitive Aerobics athletes is a long-term, systematic and complex process. The process includes different stages of material selection, basic training, special training and high-level training. Each stage will be affected by many factors, such as special, growth and development, individual differences, training venues and equipment. Intensity training brings about an increase in the probability of athletes' injuries[15]. If this phenomenon can not be improved in time, it will affect the normal training and the results of the competition . Therefore, the sports injury of Competitive Aerobics athletes will become one of the important factors that restrict the improvement of their sports performance. Mathematical statistics is an inductive study of the statistical law of random phenomena, which has a very wide range of applications in life and research . Starting from the sports injury of aerobics athletes, the statistical methods of analysis are given by the principle of mathematical statistics. Can provide us with a wealth of information . In view of the occurrence of injury, it also points out two major steps to reduce the occurrence of physical injury: one is to wear protective gear in the vulnerable part to reduce the probability of injury and the degree of damage[16]. The second is to maximize the athlete's own physical fitness. Therefore, it is necessary to define the technical level of the athletes in the investigation, in order to achieve the targeted control of the sports injury status of a certain group of competitive aerobics .

With the development of modern competitive sports towards higher, faster and stronger direction, high-intensity and heavy-load training is very common, and the proportion of sports injuries is also increasing . For sports managers, attention should be paid to adjusting the size of sports space, testing and checking the functions of sports equipment and equipment so as to ensure that they are in safe use, and drinking water supply should be adequate. Athletes' wrist parts need to bear great pressure[17]. These three kinds of difficult movements are the main movements for athletes to score, so coaches will focus on the training of these three kinds of movements . When athletes experience the process of rehabilitation and reintegration training, there are often certain cognitive and emotional responses, which are mainly influenced by individuals and the environment . In addition, the time of injury will affect the psychology of the injured athlete to varying degrees[18]. When the sports injury occurs shortly before the major competition, the athlete's disappointment and despair will be greatly enhanced . Accompanied by the increased incidence of sports injuries caused by competitive aerobics athletes. How to prevent the occurrence of sports injuries in training and competition, how to deal with the rapid and effective treatment after the occurrence of sports injuries, has become an urgent and urgent problem for coaches and athletes . Therefore, the prevention of unnecessary sports injuries in competitive aerobics exercise is prevented in advance, and the scientific diagnosis and active treatment of sports injuries cannot be avoided. It has become an insurmountable process for the development of competitive aerobics science, and it is the only way to realize China's progress from aerobic aerobics to aerobics .

Related Work

Myer G D et al. analyzed the sports injuries of high-level Competitive Aerobics Athletes in China in 2013 and concluded that the main injuries were muscle and ligament injuries, joint and cartilage injuries, bone tissue injuries and so on[19,20]. Acute injuries accounted for, while chronic injuries accounted for the main causes of Sports Aerobics athletes injuries are inadequate preparatory activities, technical errors, body fatigue, local overburdens, poor physiological and psychological reasons.[21] In 2014, Rost M and others concluded that the prevalence of sports injuries in ordinary competitive aerobics athletes in China is mostly due to the damage caused by acute injury and the insufficient damage of preparatory activities. The main stage is that the parts of the injury during normal technical training are mainly wrist and step joints.

The physical fitness of Competitive Aerobics includes body shape, endurance, flexibility, coordination, expressiveness, strength and so on. Competitive calisthenics athletes to complete the difficult set of movements in about `time'need to take higher physical capacity as the premise. Insufficient physical capacity will seriously affect the development of technology, increase the possibility of sports injury.[23] In 2016, Weiler R et al. conducted an epidemiological survey of high-ranking athletes who participated in the National Swimming Championships and Championships in China. The results show that the prevalence rate of female athletes is significantly higher than that of male athletes. Most of the injuries are acute and moderate injuries. In the winter and pre-match heavy-duty training stages, the damage is caused by the shoulders, waist and knees. The rotator cuff injury is the most.[24]

MATERIALS AND METHODS

The study is Purely observational studies which no need to registry ID of ICMJE, and all the participants were reviewed and approved by Luzhou Vocational and Technical College, China (NO. 2022011)

Competitive aerobics requires Competitive Aerobics athletes to have good flexibility, super strength, endurance and strength speed. These qualities are the premise of high-intensity training for athletes, and high-intensity training is prone to acute injury. Sports injury can be divided into open injury and closed injury according to the integrity of the skin or cat membrane after sports injury. According to the mathematical statistics method, the basic database is established and the data is cleaned up, the distribution characteristics of each index are described, and the skewed data is normalized to prepare for data analysis. The basic characteristics of the indicators are summarized in Table 1 and Figure 1.

Table 1. Summary of Basic Characteristics of Indicators.

	Mean number	Standard error
Rotating preload coefficient	3.60	2.20
Rotating afterload coefficient	2.91	2.45

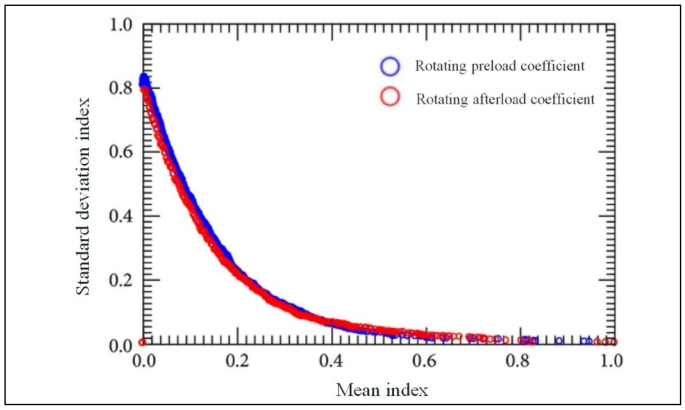

Figure 1. Summary of Basic Characteristics of Indicators.

Competitive aerobics has attracted more and more attention of many athletes for its unique jumping and difficult movements. Its complete set of movements must show continuous combination of movements, flexibility and strength. Long-term exercise will increase the lactic acid in the muscles of competitive aerobics athletes. As a result of accumulation of lactic acid, Competitive Aerobics athletes will feel muscle soreness, stiffness, fatigue, depression and lack of confidence subjectively.

Chronic injury is due to the inappropriate treatment of acute injury, untimely treatment after injury, unhealed injury, early training, multiple injuries and so on. Sometimes it happens because of improper training arrangement, excessive local training or excessive burden. The injuries of athletes at different levels are investigated as shown in Table 2 and Figure 2. The difficult movements of aerobics athletes are all movements of jumping and supporting. When the body part suddenly exerts force, there are many reasons. When landing, due to unstable center of gravity and poor physical quality, acute injury may occur. The investigation of the injury course of athletes at different levels is shown in Table 3 and Figure 3.

The order of the possibility of motion damage caused by different sets of internal motions is shown in Table 4 and Figure 4. Therefore, the perfect completion of all kinds of difficult movements of competitive aerobics has a potential impact on the sports injuries of competitive aerobics athletes. The injury of a high-level athlete can not only be seen as an injury to the individual athlete, but should rise to damage the property of the entire country. The society pays attention to comprehensive, coordinated and sustainable development, and the development of athletes should be more so.

RESULT ANALYSIS AND DISCUSSION

The frequency of judging frequency of sports injury factors of high-level competitive aerobics athletes is shown in Table 5 and Figure 5. The injury is more serious, the injury is not cured, and the premature training not only affects the normal training, but also makes it easier to cause secondary injury to the injured part and increase the risk of sports injury. Therefore, timely and effective treatment of injuries, prevention of disease and injury training, has played a very good role in the prevention of sports injuries of competitive aerobics athletes. In addition, if the knee joint is larger than the angle when the knee is bent, the knee joint will be subjected to excessive load. Therefore, excessive load on the body will lead to the injury of competitive aerobics athletes.

Constructive validity refers to the degree to which a test can explain a certain structure or trait in psychological theory. It is mainly applicable to the determination of validity of psychological tests:

$$P_g = (P_{g1}, P_{g2}, P_{g3}, ..., P_{gd})^T \quad (1)$$

Table 2. Investigation on Injury Nature of Athletes at Different Levels.

	Number	Proportion
Closed injury	36	0.6
Open injury	24	0.4

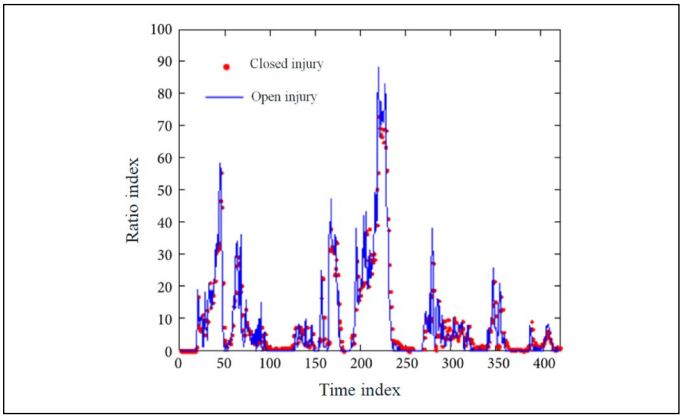

Figure 2. Investigation on Injury nature of athletes at different levels.

Table 3. Investigation on Injury Course of Athletes of Different Levels.

	Number	Proportion
Acute injury	36	0.65
Chronic injury	24	0.35

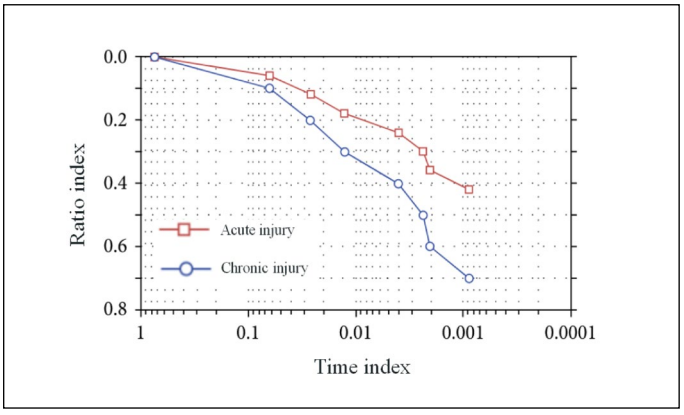

Figure 3. Investigation on injury course of athletes of different levels.

Table 4. Ranking of the Possibilities of Sports Injury Induced by Internal Boundaries of Different Complete Movements.

	Train	Control
Difficulty movement	6.75	5.16
Lift up	7.22	6.19
Transition link	5.19	5.91

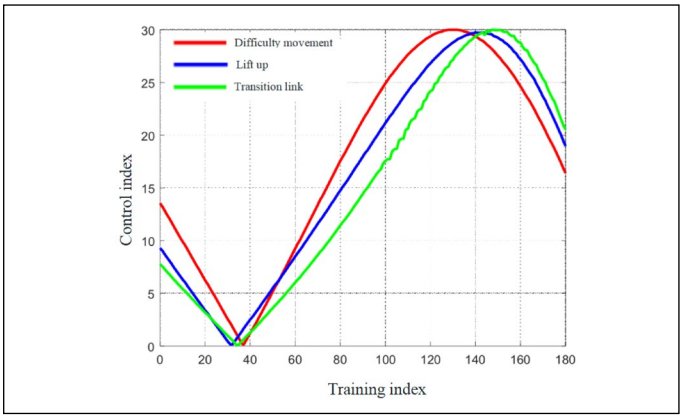

Figure 4. Ranking of the Possibilities of Sports Injury Induced by Internal Boundaries of Different Complete Movements.

Table 5. Frequency Statistics of Determining Injury Factors of High-level Competitive Aerobics Athletes.

	Train	Adjustment
Physical factors	0.82	0.31
Skill factors	0.72	0.26

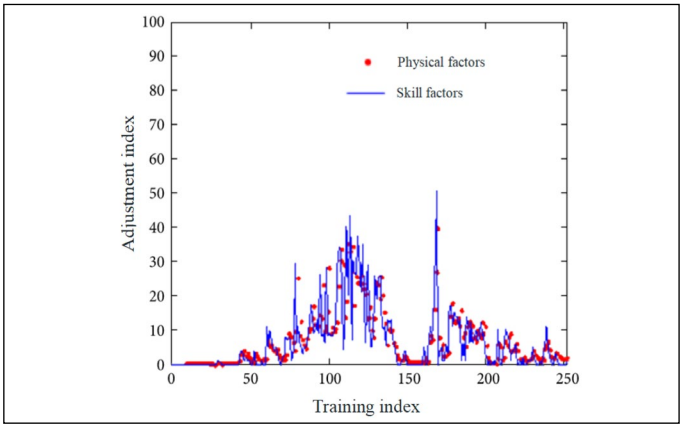

Figure 5. Frequency statistics of determining injury factors of high-level competitive aerobics athletes.

Scale-related validity refers to the degree of consistency between test scores and the results of another independent test as a criterion:

$$V_{id} = wV_{id} + c_1 r_1 (P_{id} - X_{id}) + c_2 r_2 (P_{gd} - X_{id}) \quad (2)$$

Analysis of the Formula Model of Athletes' Psychological Structure and Its Reliability Test:

$$P_g^t = (P_{g1}^t, P_{g2}^t, P_{g3}^t, ..., P_{gd}^t)^T$$
$$P_{gi}^t = P_{gi}^t (1 + 0.5\eta), i = 1, 2, ...d \quad (3)$$

Approaching a finite value, it becomes a continuous function and redefines it as:

$$e_j = -k \sum_{i=1}^{n} f_{ij} \ln f_{ij} \quad (4)$$

$$W_j = 1 + k \sum_{i=1}^{n} f_{ij} \ln f_{ij} \Big/ \sum_{j=1}^{m} (1 + k \sum_{i=1}^{n} f_{ij} \ln f_{ij}) \quad (5)$$

Normally, the standard score is not easy to obtain, so we can use the total test score to replace, and find the correlation coefficient between the score and the total score of the test:

$$W_j = d_j \Big/ \sum_{j=1}^{m} d_j \quad (6)$$

Secondly, the validity of a test should not exceed the square root of its reliability:

$$y_i = \frac{\max(y) - y_i}{\max(y) - \min(y)} \quad (7)$$

According to the definition of the transfer function, the transfer function of the damage mode is known as:

$$i_t = (1-\rho)\left[r^* + \pi_t + \alpha(\pi_t - \pi^*) + \beta(y_t - y_t^*) + \gamma e_t + \delta m_t\right] + \rho i_{t-1} + \xi_t \quad (8)$$

$$i_t = \alpha_c + \rho i_{t-1} + \alpha_\pi \pi_t + \beta'(y_t - y_t^*) + \gamma' e_t + \delta' m_t + \xi_t \quad (9)$$

Combine the scores of different experts and find the coefficient through data fitting:

$$i_t = \alpha_c + \alpha_{\pi t} \pi_t + \beta_t'(y_t - y_t^*) + \gamma_t' e_t + \delta_t' m_t + \xi_t \quad (10)$$

According to the mathematical statistics method, the differential equation of motion with strain as the basic unknown is obtained:

$$U_{ij} = \frac{H_{ij}}{\sqrt{\sum_{t=1}^{k} H_{it}^2}}, i = 1, ..., n, j = 1, ..., k \quad (11)$$

Calculate the skew coefficient by the following formula:

$$P = I - A^{-1/2} M A^{-1/2} \quad (12)$$

Preventing them from increasing the damage during the competition due to excessive tension, and through psychological training, the method for the competitive aerobics athletes to quickly adapt to the game environment and adjust the state psychological training is shown in Figure 6. Therefore, the science of training organizations is an important condition for athletes' competitive ability. The organizational implementation of the training includes the injury factors such as preparation activities, local burdens, overall load, finishing activities, and quality training.

Athletes should face up to the risk of injury and minimize the loss. There are many reasons for injury, which can be divided into direct causes and inducing factors, and inducing factors are potential causes. It depends on the anatomy of human tissues and organs, physiological and functional characteristics and the technical characteristics of sports itself. The causes of sports injury are shown in Figure 7. In addition, when building a comprehensive physical fitness, it is necessary to constantly correct the posture of the movement and develop the flexibility of the vulnerable part.

CONCLUSION

This paper analyses the characteristics of sports injuries of high-level Competitive Aerobics athletes by mathematical statistics. Enhance athletes' awareness of preventing sports injury, standardize movement technical specifications, establish dynamic stereotyping, strengthen physical training, improve physical fitness, attach great

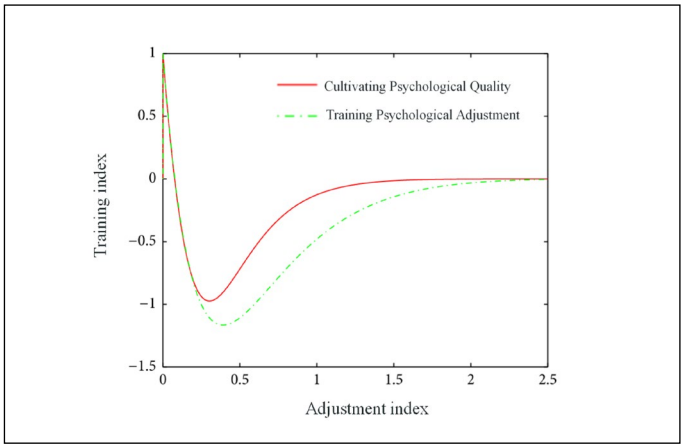

Figure 6. The Method of Psychological Training.

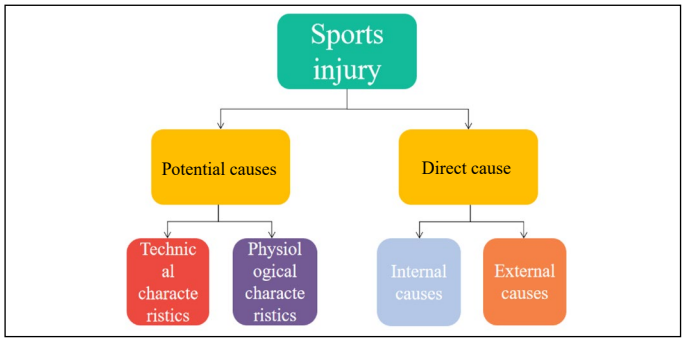

Figure 7. Causes of Sports Injury.

importance to preparatory activities, and avoid sports injury. In the health period before injury, we should take various measures to improve physical fitness and skills to do a good job of health care in the acute period after injury, grasp the working principle of early diagnosis and early treatment, and seize the best treatment time. When the shape of the muscle is roughly restored, enter the training of muscular endurance, and take a quick force exercise with a small load for several times until the muscle strength, muscle endurance and muscle speed around the affected part are restored, and special technical training can be started. Introduce outstanding talents in the physical rehabilitation major to guide the injury prevention and rehabilitation exercises. In technical training, the coaches must have a choice and focus on instilling technical movements into the athletes. At the same time, the coaches need to study the similarities and key technologies of the technology in detail, through the movement of learning and learning, combined with the physical and personal characteristics of each athlete.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. Weizhen Shen: writing and performing surgeries; Qunying Zhou: data analysis and performing surgeries, article review and intellectual concept of the article.

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