

## Research on Pilots' Anti-g Ability Training Scheme Based on Physiological Function

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**Abstract:** Anti-Load Capability is the Ability of Aircrew to Bear Acceleration Load, Improve the Anti-Load Capability of Aircrew and Reduce the Harm of Acceleration Load to Flight. It is One of the Important Tasks of Aviation Sports Training. in Order to Ensure Flight Safety, Besides Using Corresponding Protective Equipment, Pilots Also Need to Have Strong Physique, Good Muscle Strength and Endurance, So Pilots Must Carry out Long-Term and Systematic Physical Training. At Present, Measures to Improve the Anti-Load Ability of Pilots Include Physical Training, Anti-Load Movement Training, Anti-Load Positive Pressure Breathing Training and Centrifuge Training. Anti-g Physiological Training is of Great Significance for Improving the Acceleration Endurance of Fighter Pilots, Preventing Black Vision and Syncope in the Air, and Ensuring Flight Safety. Based on the Physiological Function of Pilots, This Paper Analyzes the Mentality of the Trainees and Integrates the Concepts and Methods of Modern Physical Fitness Training, So as to Study and Formulate a Set of Scientific and Practical Anti-Charge Physical Fitness Training Scheme.

### 1. Introduction

The Flight Activities of Modern High-Performance Fighters, Especially High-Load Flights, Will Have Some Adverse Effects on Pilots. Aircraft Will Generate Acceleration When Flying At Variable Speed or Curve. in Aviation Engineering, the Ratio of This Acceleration to Gravity Acceleration is Called "Overload" [1]. in the Presence of Acceleration, a Series of Physiological Function Changes Will Take Place under the Influence of Inertial Force. in Order to Ensure Flight Safety, Besides Using Corresponding Protective Equipment, Pilots Need to Have Strong Physique, Good Muscle Strength and Endurance, So Pilots Must Carry out Long-Term and Systematic Physical Training [2]. with the Development of Science and Technology and the Progress of Technology, More and More High-Performance Fighter Planes Are Put into Use in the Army, and the Occurrence Rate of Air Consciousness Loss is Obvious [3]. Many Countries Have Attached Importance to the Physical Training of High-Performance Fighter Pilots. Nato Countries Have Drawn Up Their Own Physical Training Plans for Pilots. Russia Also Places Special Emphasis on the Importance of Physical Fitness Training. Its Training Plan Focuses on Improving Abdominal and Leg Muscle Strength and Will Try Its Best to Last Longer [4]. through Training, Pilots Can Correctly Master the Antagonistic Actions, Enhance the Contraction Strength of Skeletal Muscles, Strengthen the Compensatory Adaptability of the Body, and Improve the Endurance to Acceleration [5].

At Present, Measures to Improve the Anti-Load Ability of Pilots Include Physical Training, Anti-Load Movement Training, Anti-Load Positive Pressure Breathing Training and Centrifuge Training [6]. in Aviation Medicine, the Extra Load Borne by the Aircrew Due to Inertial Force during the Acceleration Movement of the Aircraft is Called "Acceleration Load" [7]. the Magnitude is Measured by Taking Inertial Force as a Multiple of the Normal Weight of the Aircrew and Expressed by "g". Anti-g Physiological Training is of Great Significance for Improving the Acceleration Endurance of Fighter Pilots, Preventing Black Vision and Syncope in the Air, and Ensuring Flight Safety. in Flight, the Greater the Acceleration Generated by the Aircraft, the

Greater the Acceleration Load Borne by the Flight Personnel [8]. the Acceleration Load Can Be Divided into Positive Acceleration Load, Negative Acceleration Load and Lateral Acceleration Load According to the Direction in Which Acceleration Acts on the Flight Personnel [9]. in Order to Improve the Effect of Anti-Dutch Physiological Training, This Paper Analyzes the Mentality of the Trainees and Integrates the Concepts and Methods of Modern Physical Training. Therefore, a Set of Scientific and Practical Anti-Dutch Physical Fitness Training Program Has Been Developed, Hoping to Play a Positive Role in Ensuring the Training Quality.

## **2. Analysis on Current Situation of Anti-Charge Ability Training**

A large number of studies have proved that +GZ endurance can be obviously improved by using heavy weight and 9-12 weeks of anaerobic training such as weightlifting or weightlifting-like training. Specific cervical muscle training can relieve cervical muscle fatigue and indirectly increase +GZ endurance. In the basic training phase of flight, the new trainees will start intensive physical fitness training as soon as they enter the school. The main content is upper limb strength training with horizontal bar leading up and parallel bar arm flexion and extension. In a short period of time, the upper limb strength of the flying cadets will be improved rapidly, and constant training will be carried out. Pilots recuperate for one month every year and carry out aerophysiological training and physical exercise during recuperation. Anti-G physiological training can improve the endurance of pilots against +Gz. The anti-load training of students in the basic stage of flight mainly runs through the process of physical fitness training, and there is an unreasonable match between strength training and aerobic training in organizational training. For some pilots with many worries, they should focus on psychological counseling and patiently explain that anti-Dutch physiological training is painless and very safe. The +Gz endurance of pilots can be obviously improved by non-continuous resistance training for three days per week and running or aerobic training three times a week on alternate days.

People and environment are unified. People must and can adapt to the stimulation of various environmental factors by temporarily changing their inherent biological rhythm. When the intensity of this stimulus exceeds the inherent biological rhythm intensity of the human body, the new adaptability generated by the human body will cover up the original biological rhythm. If the training load is too large and exceeds the body's bearing capacity and adaptation threshold, it will cause overtraining, overtraining or training damage [10]. Pilots should be instructed to fill in the anti-G physiological training questionnaire carefully and master the basic acceleration endurance of each pilot. If you have a cold, obvious lack of rest and improper diet, you can cancel this training or reschedule the training to ensure the safety of the training. In order to achieve the scheduled goal of competition or training, pilots should not only have sufficient physical strength and flexible technical and tactical application, but also have good will cooperation. Its characteristics are mainly reflected in its correct understanding of training techniques and tactics, its flexible use of tactics and its effective control of its own psychological activities. Physical fitness has different effects on the level of competitive ability.

## **3. Formulation of Anti-Dutch Physical Fitness Training Scheme**

### **3.1 Reasonable Curriculum Setting**

The curriculum of physical fitness training is very important to improve the anti-load ability of flying cadets. The content, time, organization and examination all affect the effect of anti-load training. The human body is a very complex multi-degree-of-freedom motion system, and it is very difficult to simulate the actual situation of the human body in the motion process. Therefore, at present some modeling methods often simplify the human body to different degrees to obtain an approximate model of the human body. However, the simulation effect is not ideal, and the main reason is the error caused by simplification of human body. Especially in special sports with large muscle deformation, the use of simplified models may bring more errors. Raising pilots' awareness

of the importance of training, relieving their worries and increasing their sense of security are powerful guarantees for the smooth progress of anti-Dutch physiological training. In terms of training content, aerobic training and anaerobic strength training are not conducted at intervals, which neither conforms to the laws of physical exercise nor can effectively improve the anti-load ability. The human body system model provides a tool for studying human body biomechanics and increases the research scope of human body biomechanics. It is necessary to establish such a perfect human muscle movement system model, thus providing a powerful tool for studying human biomechanics.

### 3.2 Scientific Organization of Physical Fitness Training

It is necessary to change the traditional concept of physical exercise and integrate the improvement of the anti-Dutch ability of flying cadets into physical training. At the same time, following the rule of improving the anti-load ability, the physical fitness training of the students should be combined in class and after class, and the strength training and endurance training should be carried out every other day. In the whole process of the development of the human body's movement pattern, if there is a problem in one of the links, it will lead to obvious movement restriction or dysfunction. Only on the basis of proficiency can the speed of tactical application be improved. The architecture of special exercise method is shown in Figure 1.



Fig.1 Architecture of the Special Movement Method

Good physical fitness is the basis for pilots to bear heavy load training and high-intensity flight recognition tasks and maintain a stable and good psychological state. If the electromyography signal of muscle cannot be measured by surface electromyography signal, the electromyography signal value of deep muscle can be measured by reference electrode. Calculate the muscle length, muscle contraction or stretching speed at each moment. A muscle algorithm based on kinematic parameters can be adopted, and the muscle force of the method is expressed by the following formula:

$$E_{non-CH} = lE_{elec} + l\xi_{fs} d_{toCH}^2 \quad (1)$$

Where  $d$  represents the force of the contraction unit and  $r$  represents the force of the parallel elastic unit, which is calculated by the following formula:

$$E[d_{toCH}^2] = \iint (x^2 + y^2) \rho(x, y) dx dy = \iint r^2 \rho(r, \theta) dr d\theta \quad (2)$$

In the formula,  $k$  is the intrinsic constant of muscle, and the constant tension is calculated by the following formula:

$$E[d_{toCH}^2] = \frac{1}{2\pi} \frac{M_1 * M_2}{k} \quad (3)$$

The anti-charge ability of the pilot group showed a certain rhythm in one or more days, but there were also obvious individual differences. Whether pilots can adapt to the sports load they are subjected to is the key to scientific training. One of the important contents of pilots' physical function evaluation is to scientifically evaluate pilots' adaptability to load. If the training load is too

small and the body cannot get enough stimulation, it will not be able to effectively improve the exercise ability. At present, auxiliary breathing equipment is mostly used in high-performance fighter planes. If pilots do not have ground anti-load positive pressure training, it is difficult to adapt to the auxiliary breathing system on board, which will cause breathing difficulties and the anti-load effect of the equipment is difficult to play. During the training, the blood pressure and various display data on the biofeedback anti-charge trainer are closely observed to verify the accuracy and training effect of the confrontation actions taken by the pilots, and guide the pilots to practice repeatedly until they master the confrontation actions skillfully.

#### **4. Conclusions**

The maximum strength training and fast strength training can effectively improve the +Gz endurance of the flying cadets, and the training effect is better than the strength endurance training. Chinese sports science and technology personnel attach great importance to the close combination of scientific research and training practice. In terms of research project initiation, research project implementation and research results application, it is based on serving sports training practice. Sports technology refers to the method of completing specific anti-load ability training and is an important determinant of the level of anti-load ability of pilots. Reasonable arrangement of anti-load ability training by using the biological rhythm rule has obvious benefits for improving the anti-load ability of pilots and maximizing the compressive potential. One of the important contents of pilots' physical function evaluation is to scientifically evaluate pilots' adaptability to load. In order to achieve the scheduled goal of competition or training, pilots should not only have sufficient physical strength and flexible technical and tactical application, but also have good will cooperation. The training of pilots in the basic training stage is still in its initial stage. The method of improving physical fitness training has not yet formed a system, and the training concepts and methods need to be further improved.

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