Compatibility of Sleeve Fabric of Tight Alpine Ski Suit with Skin Deformation

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Abstract

This paper uses a combination of alginate impression and body surface tracing to study the skin deformation mechanism of upper limbs in alpine skiing, and the sleeve pieces were divided into 5 regions combined with the characteristics of human heat and sweat. The thickness, permeability and constant elongation of 7 kinds of elastic fabrics commonly used in tight sports clothing were tested to provide a quantitative basis for fabric compatibility in different zones. The results showed that the skin deformation in the elbow joint area was significant, the transverse changes were mostly stretching, and the longitudinal changes were mostly contraction; the characteristics of heat and sweat in upper limbs were distinct, which could be divided into shoulders, upper arms and below the elbow joint; the order of fabric permeability is as follows: $6 > 3 > 7 > 4 > 1 > 2 > 5$, the order of warp tensile elastic modulus is as follows: $7 > 6 > 1 > 5 > 2 > 4$, the order of weft tensile elastic modulus is as follows: $1 > 3 > 7 > 6 > 5 > 2 > 4$; the abc zones of the sleeve are dominated by the demand for air permeability, which is compatible with 3#, 7# and 6# fabrics respectively, the de zones are dominated by the demand for tensile elasticity, which is compatible with 4# and 2# fabrics respectively.

Keywords: Skin deformation; Tight clothing; Elastic fabric; Structure partition; Alpine skiing

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1 Introduction

As the third motion feature of the human body, the skin expands and contracts during motion of different degrees, which can be used to guide the structural design and fabric selection of tight-fitting clothing [1]. Many scholars have conducted relevant research on skin deformation in recent years. Feng [2] measured skin stretch in dynamic and static postures through a 3D scanning system and discussed the convenience of protective clothing; Zhang [3] established a regression model of the lower limb joint movement angle and skin deformation rate to provide a basis for the design of longitudinal slack in pants; Luo [4] studied lower limb skin deformation, skeletal muscle activity and fabric properties to optimise the design of tight-fitting cycling shorts. In this paper, alginate impression combined with body surface tracing is used to obtain the upper limb

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skin deformation data during alpine skiing, and the sleeve structure is divided according to the characteristics of heat and sweat of the human body. Then, 7 kinds of elastic fabrics commonly used in tight sports clothing are selected for thickness, permeability and constant elongation tests to provide a quantitative basis for the compatibility of fabrics in different zones so that the sleeve fabric can better meet the needs of upper limb movement.

2   Methods

2.1   Skin Deformation Experiment

In this experiment, five young females aged 23 to 25 years, with a height of 162 cm to 165 cm and a weight of 50 kg to 60 kg, were selected as experimental subjects. Alginate was used as the experimental material, and the skin deformation experiment was carried out with body surface tracing. According to the reference points and baseline of the key parts of the human upper limb, the experimental measurement line segment was drawn, and the arm impression was carried out by selecting four basic movements in alpine skiing: sliding, downhill, rotary extension and rotary lift, as shown in Fig. 1 and Fig. 2.
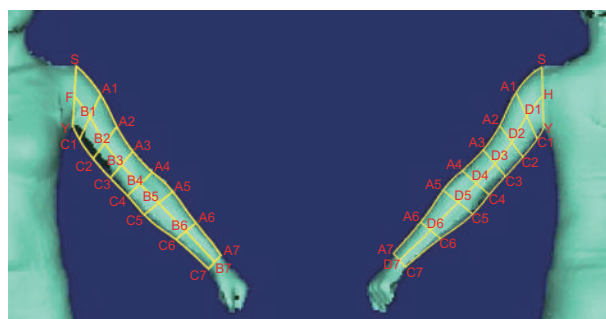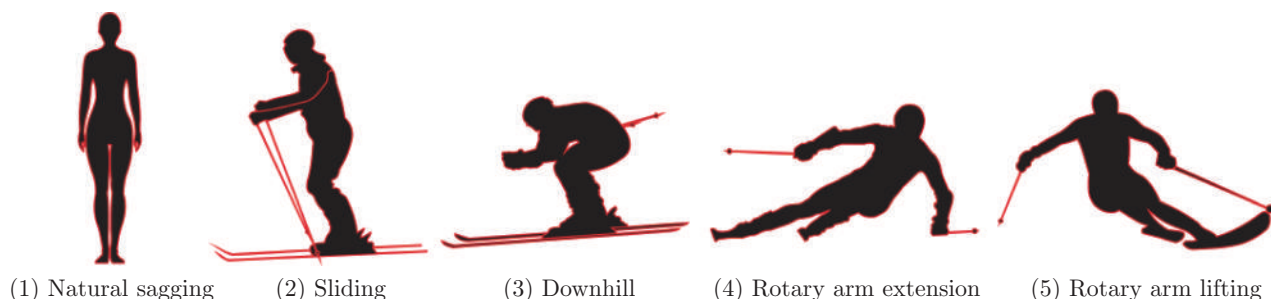

Fig. 1: Measuring line

(1) Natural sagging   (2) Sliding   (3) Downhill   (4) Rotary arm extension   (5) Rotary arm lifting

Fig. 2: Experimental actions

2.2   Fabric Testing

2.2.1   Basic Parameter Test

Seven kinds of high-elastic fabrics commonly used in tight-fitting sportswear are selected for testing. Balance, fabric thickness tester and permeability tester are used for testing, and the