

Design and Study of Clothing Structure for People with Limb Disabilities

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Abstract: The human body's features are the key to design clothing structure. Between people with physical disabilities and normal people, there are evident differences in their living requirements. Embellishment is needed because of physical distortion; as well as, functionalized design is strongly required to allow more independence in dressing and more self sufficiency in daily activities. Therefore, pattern design should encourage the health recovery, improve living style, and realize personal expectations. The final aim is to allow people with a disability a life of self-respect and facility, and enable them to mingle with family and society to a greater extent. In the past, there had been some clothing designed for people with disabilities. However most of those designs lack aesthetic consideration, and usually focus on the excessively direct aspect of function. Based on the characteristics of human body and movements, particularity for people with limb disabilities, the clothing pattern was analysed by means of real examples. Combining the knowledge of human engineering (ergonomics), textile materials and apparel technology, special modifications were designed in the garment to de-emphasize visual evidence of a person's disability, and strengthen function and convenience to meet the needs of body activities. Clothing designed for disabled people should contain elements of both function and beauty, which can help them rise to the "convenient", "beautiful" and "functional" level from the "inconvenient", "concealment" level. As a result, improvement in the quality of life of people with limb disabilities will be achieved.

Keywords: clothing structure, people with limb disabilities, functionalized design, body features, way of motion, embellishment of the body

1. Introduction

People with physical disabilities are also an important component of society. According to the statistics of "Data Bulletin and Elucidation of 2nd National Spot Survey on Handicapped in 2006", all categories of people with disabilities in China total 82,960,000, accounting for 6.34% of the total population. Among them, the number of those that are limb disabled is 24,120,000, or 29.07%. Physical differences, such as limb disability, often obstruct those in this population from participating in daily activity and communication. One of the reasons for this is a shortage in the marketplace of specially designed, functional clothing, which should be attractive and stylish in a manner similar to the garments used by normal people in embellishment, but at the same time convenient to put on and take off. Therefore, it is both necessary and meaningful to study, design, and develop clothing for people with disabilities, and is also a means of expressing our concern towards them. The specific subjects of this research are people with limb disabilities.

2. Integrating with Society: the Ideal State of Living Condition for People with Limb Disabilities

Between the people with physical disabilities and non-disabled people, there are evident differences in the living states. Due to physical differences people with physical disabilities may have psychological characteristics distinct from normal people. In order to maintain the same psychological status and social identity as normal people, the limb disabled tend to depend on prosthetic limbs and outer apparel that conceals those prosthetic limbs, which allows them to enjoy an ordinary social image. For the limb disabled, assistive devices compensate functionally for physical disabilities, and the outerwear contributes to psychological balance and self satisfaction as a powerful medium to integrate with society. Therefore, people with limb disabilities have special needs for the aesthetic and functional structures of clothing, distinct from non-disabled people, and consequently their garments have specific design requirements.

However, specialized clothing for people with

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disabilities is considerable scarce in the marketplace at home and abroad. There are very few garments designed for people with disabilities. Most functions are addressed directly, and embellishment is lacking. In addition, many people with physical disabilities choose ordinary off-the-rack clothing, thus the effect on dressing functions and appearance features are less suitable than on those of other people. What's more, apparel unsuitability usually goes beyond the physical ability of the limb disabled, as appearance without aesthetic consideration may seriously compromise their sense of self-respect. These factors impede their daily work, living, and social communication, and so reduce the quality of life. Thereby, clothing research for limb disabled people should take into full consideration their special physiological comfort and psychological tolerance. In respect to apparel materials, shape, craft, and so on, both beauty and decency are required by way of building confidence and allowing people with limb disabilities to really participate in society and live a relatively ideal life.

3. Principles of Clothing structure Design for People with Limb Disabilities

3.1 Functionality

Because of the variety of physical disabilities, clothing for people with limb disabilities must above all be practical. Due to differences in amount of exercise and range of motion, clothing shape and structure for people with disabilities should comply with their motion characteristics and assistive devices, and facilitate their actions. Increased and detailed knowledge about the different activities of people with disabilities leads us to design clothing that meets their real requirements.

3.2 Beautification

Variations in body form often make it difficult for people with limb disabilities to dress well, which in turn strengthen their aspiration for beauty. Their clothing design must not only meet functional requirements, but also should beautify body shape and enhance self-confidence. Research demonstrates that people with limb disabilities have a greater requirement for aesthetic consideration in apparel design than the non-disabled. Their social experience creates a thirst for a fashionable and unprejudiced appearance.

4. Research on Clothing Structure for People with Limb Disabilities

4.1 Analysis of Body Features of People with Limb Disabilities

Due to variations in body feature shape, size, and mobility, people with limb disabilities express changes in relative body area and component parts to different degrees, as well as a large complexity and diversity of body form. According to our research, the body features of people with limb disabilities frequently exhibit one or more of the following three characteristics.

4.1.1 Imbalance of the Body Features

Some people with limb disability, such as those with a disabled lower limb, are inclined to lose the balance of body feature because of injuries and changes in form. Want of regional body functions will affect the related body area, usually in the form of vertebral curvature, which will result in left-right asymmetry and irregular body shape.

4.1.2 Healthy Body Parts' Compensation for Disabled Body Parts

Poor blood circulation and lower skin temperature of the body parts of people with disabilities, such as the residual limbs of amputees and the feet of poliomyelitis patients, tend to weaken the muscle functions and lead to muscular atrophy. In order to compensate for the impairment of the affected body parts, the unaffected body parts are forced to endure more pressure and accomplish more functions, and so are usually endowed with more powerful muscles and more flexible joints. For example, people with lower limb disability often have healthier and stronger upper limbs and people with upper limb disability more flexible and powerful lower limbs

4.1.3 Body Features Due to Assistive Devices

Assistive devices, one of the means to facilitate the daily activities of people with disabilities, can help to support and recover the impaired body parts. However, they can also lead to the evident expansion of relevant muscle groups and serious dependent formation, such as a significant increase in width and

body circumference of a single crutch user's force location.

Again, due to individual differences and degrees of variation, these three body features may coexist in one individual with a disability.

4.2 Illustrations of Clothing Structure Design for People with Limb Disabilities

With respect to the particular needs of each individual, we will indicate specific examples and discuss those solutions for clothing structure design for people with limb disabilities.

4.2.1 Conventional Design and Function-Preferential Design

Due to the special requirements of participating in outdoor activities and the special living conditions of people with disabilities, tri-dimensional design is proposed to facilitate usage of personal motor vehicles.

Case 1: All-weather Coat for People with Lower Limb Disability

People with lower limb disability often travel by personal motor vehicle. It is one of their indispensable transportation means. In order to improve the degree of comfort in usage, we have performed tentative research on the compound dressing of people with disabilities and their mode of transportation. This compound all-weather coat helps people with disabilities adapt to weather changes

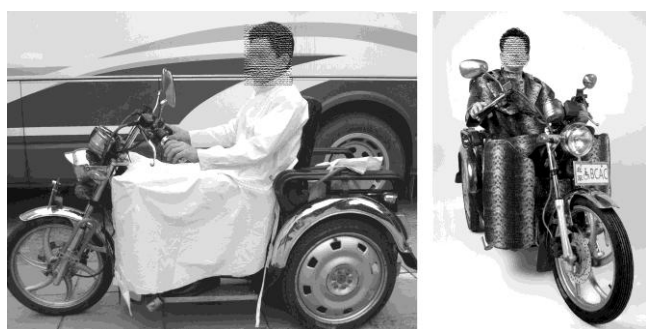


Figure 1 Sample and finished clothes of Case 1

and provides convenience during outdoor activities (Figure 1).

The initial design of this wind coat elongates the front panel, which can then be folded to a shorter length, and may be applicable to movements by both crutch and wheel chair while improving warmth retention (Figure 2). However, from communication

with people with disabilities, we know that they prefer a personal motor vehicle to wheelchairs due to the limited living space and imperfect barrier-free facilities in public areas. A compound windbreaker is what they really need. The design details adopt the classical elements of international windbreaker brand Burberry. Every detail of the inside/outside-twinset demonstrates functionality.

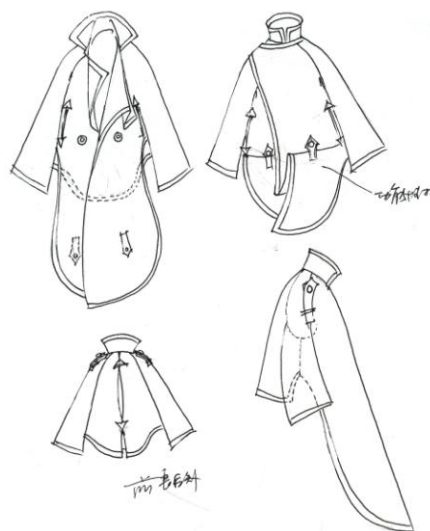


Figure 2 Sketches of Case 1

The model has a healthy upper body and lower limb impairment, so he relies on his upper limbs to stand up and move. The exercise of the upper limbs over a long period has made his upper body very strong. The entire body weight is supported on the arms with the aid of a crutch, which causes the shoulder muscle group (including pectoral, latissimus dorsi, deltoid, and trapezoid muscles) to be inordinately strong and creates asymmetrical body features (left and right arm circumference and the length of the waist point), as shown in Table 1. They look no different from other people when they sit on personal motor vehicles while participating in outdoor activities. The disability is not obviously seen.

Table 1 Body Measurements of Model 1

Parts	Size (cm)
Front Waist Length (Left/Right)	44/45
Back Waist Length (Left/Right)	42/46
Arm Circumference (Left/Right)	32.5/36
Chest Circumference	103
Shoulder Width	50

The waist position is separated by zippers, so that it is convenient for the rider to mount and dismount the personal motor vehicle. The entire garment is separated into upper and lower parts from the waist position, and the upper part includes inside and outside components. The inside component is connected with the motor vehicle by zippers. The outside part looks like a mantle, utilizing construction methods such as segmentation, breaking joint, and expansion. The wind coat is designed in a loose and built-up style; the silhouette is straight, like a box or a case. The outside mantle, in an A-shape, facilitates the stretching of the arms, the bending of the body, and the putting-on and taking-off of the garment, with the sleeve covering from shoulder to elbow and the back of the garment covering the entire back rest of the vehicle. Rider and personal motor vehicle are combined together to resist rain. The ease is 30cm, and there is a relative larger ease at the position of armhole and back width. Possessions can be carried in a functional pocket in the side position of the garment panel covering the motor cycle (Figure 3).

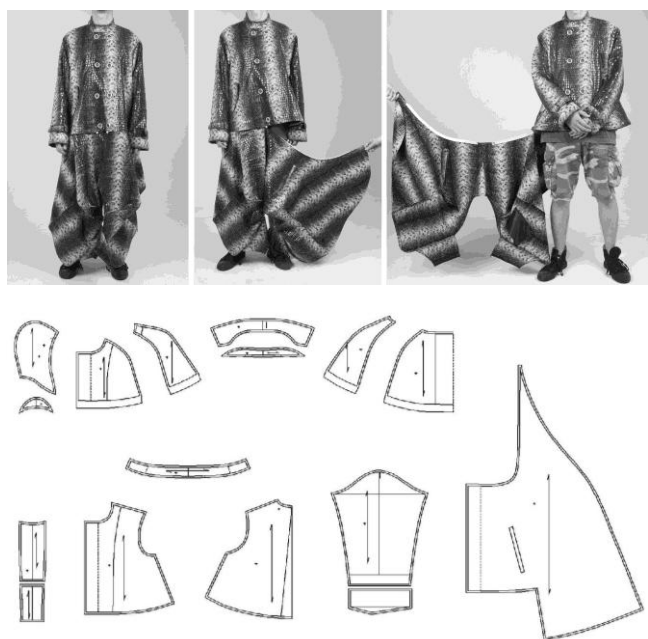


Figure 3 Details and patterns of Case 1

The special design, combining rider and personal motor vehicle perfectly, covers and protects the person with disabilities in the lower limbs, satisfying function, comfort, and fashion needs at the same time, while strengthening self-confidence and enhancing self image.

4.2.2 Asymmetrical Body Feature and Symmetrical Clothing Design

Human body features are the fundamental foundation of clothing design. This sentence should be restated. The keystone of structure design is not the simulation or complete mimicry of body features, but the beautification and modification of body features with the condition of satisfying the basic body functions. Clothing design for people with disabilities is the central embodiment of this notion.

Case 2: Formal Dress of People with Upper Limb Disability

In this case, model's upper body is disabled, with two arms amputated from the humeral head, no artificial limb fixed and healthy lower limbs. The disability has reduced the exercise of bones and muscles in the upper body; muscle attachment on the trunk; chest circumference; shoulder width; shoulder thickness; the proportion of armhole width to front-and-back width (about 24%); and also body balance. The specific characteristics are: left/right shoulder height difference of 2.5cm; front/back waist joint length difference of 1.5cm; more narrow as a whole, but with strong lower limbs (Figure 4, table 2) .



Figure 4 Body characteristics of Model 2

Tops and pants use materials in the same color and fabric to reduce the visual effect of imbalance in upper and lower body features. The combination of light colors inside and deep colors outside with similar elements emphasizes the proportional relationship of the upper/lower separation line and presents the aesthetic property of the clothing as a whole unit.

Table 2 Body Measurements of Model 2

Parts	Size (cm)
Front Waist Length (Left/Right)	46/44.5
Chest Circumference	77
Hip circumference	92
Front/back width	30/31
Shoulder Width	39
shoulder height	2.5

The stress on the structural design is to use different sizes to emphasize the thickness and width of the body features as well as to use filling materials to balance the visual effect. The core element is the design of shoulders, which should be made in the shape of warped shoulders and be modified by tri-dimensional method. Shoulder pads can compensate for the left/right shoulder height difference of 2.5cm, by designing a concave surface in the middle of the shoulder pad and a higher shoulder tip at the position of one third. The outside material is made in the shape of warped shoulder and both sides of the shoulder pads widen the armholes and shoulders. As showed in Figure 5, the shoulder width and thickness is elongated to 2cm wider by the shoulder pads. For the lower limbs considering the major movement functions, the upper/lower horizontal segmentation is set at the most slender position of the waist line to facilitate the movements.. At the same time, it reduces the visual effect of asymmetry and beautifies the overall appearance (Figure 5).



Figure 5 Sample, finished clothes and patterns of Case 1

4.3 Discussion

(1) People with disabilities need different clothing for different situations and activities. The garment in Case 1 is a fundamental way to solve the problem. It changes from the initial, purely functional design to the ultimately more aesthetic design by using fabrics of different thickness and materials, such as wind proof and water proof materials, to address different requirements of different seasons and various weather conditions.

(2) In order to meet the special requirements of people with disabilities and improve their practicality, different types of clothing must use different kinds of fabrics, such as antibacterial, humidity elimination, water proof, warmth retention, and wear-resistant materials. The well reasoned arrangement of these various materials can fully realize function, protect the body, and make the person more comfortable. Therefore, it is one of the key factors in clothing design. What's more, specialized functional materials always cost more than ordinary materials. The overuse of them would increase the cost and may well exceed people with disabilities' purchasing power. Their potentially lower purchasing ability contributes to the requirements of buying clothes with higher functionality at lower prices. More systematic and thorough research should be carried out to develop reasonably priced arrangements of structure and fabric.

(3) Body features of people with disabilities are often asymmetrical, which should be addressed in clothing design. People with disabilities variations in form can be embellished by different design methods, in order to present a stable and symmetrical visual effect.

(4) As mentioned, functionality is one of the basic principles of designing clothing for people with disabilities, but it can not be expressed too directly, otherwise the clothing will not be beautiful and elegant. Skilful design can augment functionality with design details, with particular emphasis on fashion and style; thereby, functional and aesthetic properties can be combined perfectly together.

(5) In the design process, especially the design of separation line and body part positions, both the beautification and principles of body study should be taken into consideration. For example, zippers are more suitable than buttons as closures and the position of zippers should make them easy to operate and make the wearer feel comfortable. It is better for people with disabilities to pull the zipper with forearm movement, not using the upper arm. The closing method should be more user-friendly for putting-on

and taking-off, including such design forms as draping, winding around, or single-panel bodice.

(6) The design of the opening position should improve the clothing functionality. The opening position of typical specialized function clothing, such as outdoor clothing or sports wear, is usually located at the chest, back, shoulders, or armpit. It is very convenient to be opened when it is hot, to regulate the temperature and make the wearer more comfortable. Similar designs can be applied to clothing for people with disabilities, but special attention should be paid to the opening position, size, and method, in order not to entangle assistive devices and endanger the wearer. As people with disabilities need to use assistive devices such as artificial limbs or walkers, the opening position should be located at positions required for more convenient use and longer service life of the garments.

5. Conclusion

Disabilities often lead to special functional requirements for clothing and other textile products in the living environment, which enhance functions of physiological, mental, and physical comfort. Despite their physical difference, people with disabilities want to gain a sense of social identity and acceptance like any other person. Compared with people with no visible disabilities, their requirement for aesthetically pleasing clothing may be even stronger. They may have reduced earning ability, to a certain extent, due to their physical impairment, and as a result, their purchasing power may be relatively lower. Their special requirements for clothing design, material, and construction are critical to their quality of life.

In conclusion, clothing for people with disabilities should satisfy the following standards in terms of style and structural design:

- (1) Putting on and off independently and conveniently;
- (2) Clothing variation in body features while presenting no distinction from others;
- (3) Providing a physical and psychological sense of comfort and stability;

- (4) Offering reasonable purchase price and easy to wash and maintain.

As with anyone, people with disabilities have the right to pursue individuality in fashion. Aesthetically pleasing clothing deemphasizes their disability, beautifies their outward appearance, and enables them to enjoy a healthy psychological context.

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