Personalizing of Spectacles

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Abstract

Spectacles are vital for correcting vision. Individuals who need vision correction can choose to wear spectacles or contact lenses. Alternatively, they may choose to have a vision-correcting operation. Therefore, researchers focus on vision science and spectacle design. Although some studies have compared spectacles and contact lenses for better visual quality, there is no consensus regarding which are better for the correction of vision.

With the development of technology and the improvement of living standards, the design and production of spectacles will focus on personalized style, lenses, and frames.

In this paper, we introduced trends in spectacles and studies of the relationship between frame sizes and face sizes, attempting to provide a feasible program for the personalization of spectacles-the Personalized Spectacles Program. Furthermore, certain limitations, such as non-personalized and misused spectacles, which have elevated the importance of the design and production of personalized spectacles were discussed. (***Eye Science 2012；27：220-224***)

Keywords：spectacles；personalize；frame

Introduction

Spectacles are a basic aid for correcting defective vision. Individuals who need vision correction can choose to wear spectacles or contact lenses. Alternatively, they may choose to have a vision-correcting operation, perhaps because contact lenses have some drawbacks, such as greater expense, regular aftercare (there are several kinds of daily-wear contact lenses), discomfort, and risk of infection risk. However,

vision-correcting operations have shortcomings, such as high expense, and possible infections caused by byproducts used after the operation[1,2]. Therefore, researchers in vision science and spectacle design have compared the visual quality of spectacles and contact lenses. However, there is no consensus on which is better for the correction of vision[3-13].

With the development of technology and the improvement of living standards, the design and production of spectacles will focus on personalized style, lenses, and frames.

In this paper, we introduce trends in spectacles and studies of the relationship between frame sizes and face sizes. We attempt to provide a feasible program for the personalization of spectacles—the Personalized Spectacles Program. Furthermore, we discuss problems, such as non-personalized and misused spectacles, which have led to the increasingly important role of the design and production of personalized spectacles.

Personalizing of spectacles

Style personalizing

Wearers of spectacles require designs that go beyond simple function. The influence of personalized style is weighted toward the wearer's attractiveness. This request for personalized style includes lenses, frames, arms, and so on.

Lens shapes

There are five usual lense shapes：pentagonal, elliptical, big round, rectangular, and small rectangular. There is a lens shape to suit every face shape. In the pursuit of beauty, lense shapes must show off the positive attributes and de-emphasize the negative features of the patient[14].
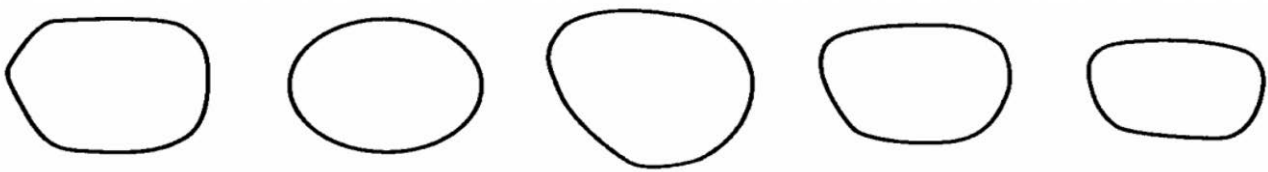
Styles of frames and spectacle legs

Figure 1 Lens shapes

Styles of frames and spectacle legs may be the most personal part of patients' selection process because of the variety shapes and colors available. Every spectacle company designs its own popular styles of frames and spectacle legs, like clothes or jewelry companies do. There are several classical styles of frames and spectacle legs available on the market.

Lenses personalizing

In addition to lens shapes, colors, and style, lense personalizing focuses on lense functions.

Aspheric surface design and double aspheric surface design

Lens optical and sight scope are negatively affected by spherical aberrations of the lenses. Double aspheric surface lenses were invented in Japan, which properly solved the spherical aberration and acquired good lens optical and sight scope.

Aspheric surface design of light tracing

Based on double aspheric surface design, light tracing design considers eye movement and feeling in the correction of spherical aberration (cross spherical aberration). Subsequently, a distance-revising lens adapted to varied sights, was designed. (Figure 2 shows some commercially available products).

Unsymmetrical design in horizon sight

When people look at close objects, the angles of the left and right eyes as they look through lenses are not equal. Hence, asymmetrical design of horizon sight, would be a more personalized. Although this design is asymmetrical, it balances the sight in the left and right eyes (Figure 3 shows some products available on the market).

Design of different presbyopia

A patient with a lower presbyopia needs a pair of lenses that correct both myopia and presbyopia, whereas high presbyopia requires much closer sight.
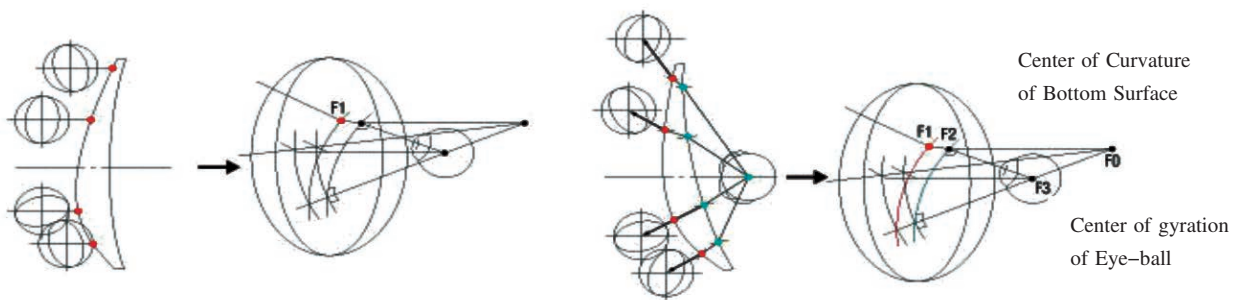

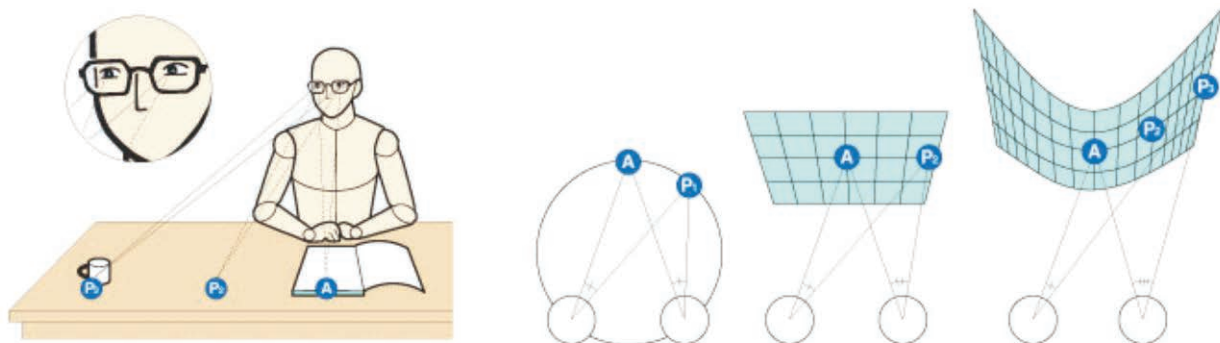**Figure 2** Aspheric surface design of light tracing (From some products)

Figure 3 Asymmetrical design in horizon sight (From some products)

More satisfactory sight is achieved by designing different presbyopia for varied requirements.

Frame personalizing

It is vital to get a proper frame for a satisfactory sight correction, especially in long-term sight health, with the exception of the accuracy of sight tests and lense production.

Statistic and manufacturing of frame

Considering the relationship between frame size and human facial size, most nations manufacture frames according to facial sizes that are typical in that nation[15].

To prescribe manufactured frames, the optician follows the patient's feeling about the spectacles, and then modifies the spectacle legs[16]. Sometimes, the frame can be modified by attaching a little plastic modifier, especially fixed and unchangeable frames. However, there are also some problems; First, the facial sizes of Chinese vary greatly, so it is usually unsuitable for the patient to choose a manufactured frame. Second, accurately fitting spectacles are difficult to achieve by following a patient's feeling and a sight-worker's experience, especially in young children.

Frame personalizing

Because of the shortcomings of statistics and frame manufacture in addition to the requirements of individual personalities, frame-personalizing methods have been reported in many papers recently[17-18]. The main factors in frame personalization depend on obtaining and modifying facial data photos to get a three-dimensional picture of the personality and the spectacles with a personalized frame.

Personalized frames are a wonderful prospect for personality. However, they have a long way to go because of the low accuracy of three-dimensional pictures of the face and head based on data photos. There is still little knowledge of the relationship between facial sizes and frame sizes.

Frame and face sizes

（1）Front sizes

The sizes of face or frame are defined as follows：

D is the pupil gap

L_1 is the wide of frame

l_1 is the distance of both centers of stipule of spectacle

l_2 is the distance between the center of stipule and

the focus of the related lens

l_3 is the distance between the focus of the related lens and the horizontal edge of lens

l_4 is the distance between the focus of the related lens and the bottom vertical edge of lens

l_5 is the distance between the focus of the related lens and the up vertical edge of lens

l_6 is the height of frame

The following equations are used to determine the sizes of the front face and frame：

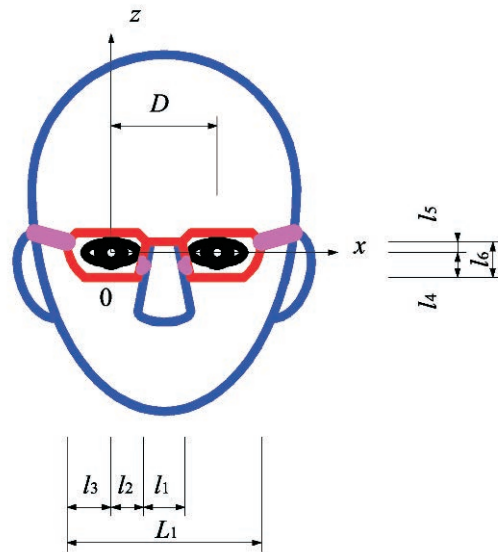$D=l_1+2l_2$，（1）

$L_1=l_1+2l_2+2l_2$，（2）

$L_6=l_4+l_5$，（3）

Figure 4　Front sizes

（2）Side sizes

The sizes of side face or frame are defined as follows：

d is the gap between pupil surface and the front point of the frame leg

L_2 is the length of frame leg, without consideration of inclining

l_7 is the distance between the center of stipule and the frame leg's front point

l_8 is the distance between the center of stipule and pupil surface

l_9 is the distance between the center of stipule and the focus of the lens

θ_1 is the inclined angle of frame leg

θ_2 is the vertical inclined angle of lens

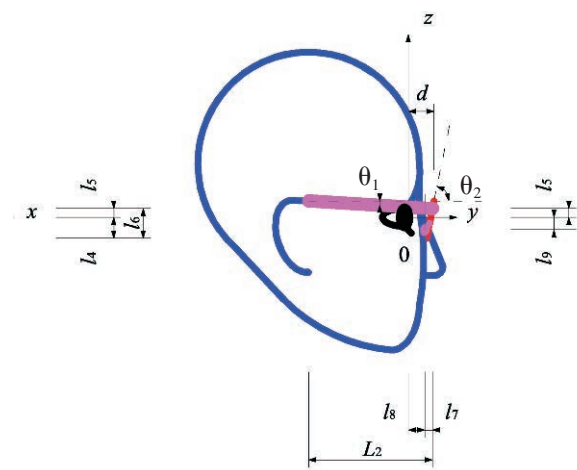The following equations are used to determine the

Figure 5 Side sizes

side face and frame:

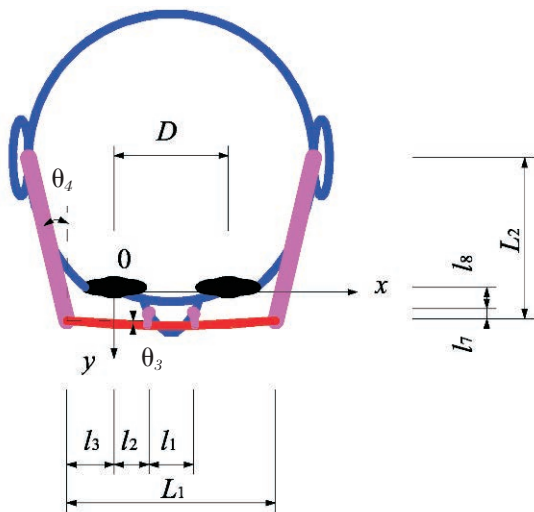$$d=l_7+l_8, \quad (4)$$

Figure 6 Projecting sizes

(3) Projecting sizes

The sizes of projecting face or frame are defined as follows (Figure 6)

θ_3 is the horizontal inclined angle of lens

θ_4 is the extending angle of frame leg

Frame personalizing and facial sizes

The sizes of the frame and the face must be harmonized in order to personalize the frame, which requires full knowledge about the essential roles of face sizes and the varied frame sizes. There are several essential facial sizes, such as $D, l_1/l_1$ and so on, which have an important role in frame personalizing.

The relationship between face and frame sizes is used to design the frame sizes. The facial sizes must be tested accurately. Furthermore, a three-dimensional test of the face with a high accuracy should be developed.

Spectacle personalizing

Spectacle personalization can be summarized as the Personalized Spectacles Program (PSP)(Figure 7).

Personalized spectacles have been achieved from the personalization of lenses, styles, and frames.
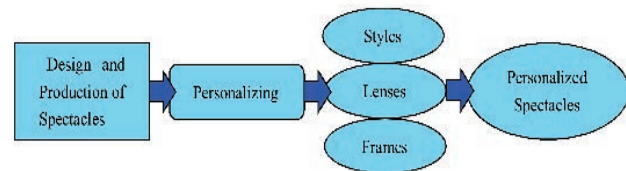

Figure 7 Program of spectacles personalizing

Discussion

In the first two processes of PSP-style and lense personalizing-we obtained a pair of decent and accurate spectacles. However, frame personalizing, which is vital for the wearer's feelings and health, should not be neglected.

Improper frame sized

Frame sizes should be suitable for the facial sizes of patients. For instance, depending on the wearer, shorter or longer spectacle legs may be applied to a manufactured frame (characterized by L_2, θ_1, θ_4, and so on). The focus of the spectacles would be higher or lower than one of the pupils (see Figure 8).
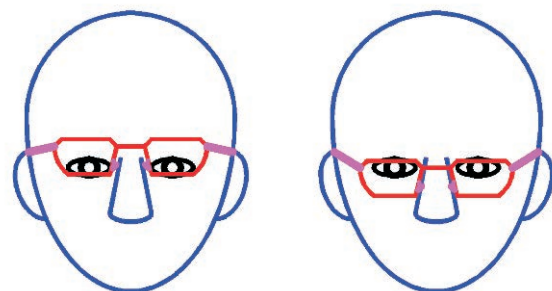

Figure 8 Spectacles worn with improper sizes of frame and asymmetrical face

Individuals commonly have some asymmetry of face. For example, the left side of the face may be smaller or bigger than the right side, so l3 should not be equal on the left and right side of the spectacles. A result of wearing spectacles is shown in Figure 9.

Improper usage of spectacle

Putting on or removing spectacles incorrectly, playing rough sports, or some other improper usage cause changes in the shape and sizes of frames, such as D, l_1, θ_1, θ_2, and so on. Some of these changes are shown in Figure 8 and Figure 9.
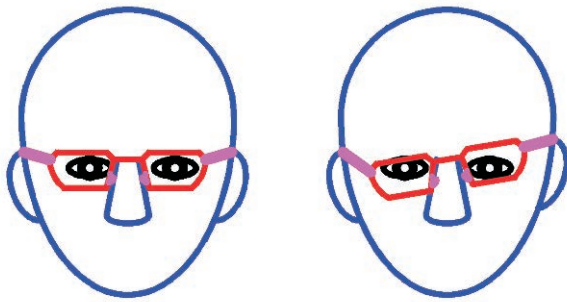

Figure 9   Spectacles worn with an asymmetrical face

Disorders or diseases of non-personalized spectacles

The non-personalized spectacles may cause disorders or even diseases in patients. That is to say, disorders could be caused by frequently lifting and removing spectacles, squeezed expressions, and so on. Furthermore, they cause rapid weakening of sight, gradual changes in the position of the pupils, and other diseases.

Conclusion

In this paper, we introduced the trend of designing and producing of spectacles that are personalized based on style, lenses, and frames.

We introduced studies of the relationship between frame sizes and face sizes, and tried to provide a feasible program for the personalization of spectacles-the Personalized Spectacles Program (PSP). In this program, personalized spectacles are achieved by taking into account the personalization of style, lenses, and frames.

Furthermore, we discussed some problems caused by non-personalized and misused spectacles. Personalized spectacles have an increasingly important role in the design and production of spectacles.

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