

DESCRIPTION

ORTHOKERATOLOGY LENS DESIGNATING METHOD, DESIGNATING SYSTEM, DESIGNATING AND SUPPLYING METHOD, AND DESIGNATING AND SUPPLYING SYSTEM

5 Technical Field

[0001]

The present invention relates to a designating method, a
designating system and a designating and supplying method, and a
designating and supplying system for an orthokeratology lens, which
10 is a contact lens used for a cornea correction treatment in which
mounting the contact lens having a special curve design changes
and corrects the shape of a cornea in order to treat an
ophthalmological refractive abnormality such as myopia, hyperopia,
or presbyopia.

15 Background Art

[0002]

Out of cornea correction treatments, a conventional treatment
described in, for example, Patent Literature 1 for correcting myopia
and astigmatism is referred to as orthokeratology.

20 [0003]

Patent Literature 2 discloses an orthokeratology lens that
is a contact lens for correcting myopia and/or astigmatism
(hereinafter, referred to as an orthokeratology lens including the
contact lens for correcting the myopia and/or astigmatism and a
25 contact lens for correcting hyperopia and/or presbyopia) according

to the invention by the present inventor.

[0004]

The curvature of the orthokeratology lens is flattened stepwise (in stages) in the case of correcting myopia, while the curvature of the orthokeratology lens is tightened stepwise in the case of correcting hyperopia or presbyopia. In the final stage, a cornea comes to have a curvature so as to have an ideal uncorrected vision.

[0005]

Conventionally, to mount an orthokeratology lens on a cornea, a plurality of candidate contact lenses, which are selected on the basis of data of a patient's corneal refractive power (hereinafter referred to as diopter or D) measured by a keratometer, are sequentially mounted. One of the contact lenses that has an optimal correction D to correct the cornea D is used as the orthokeratology lens.

[0006]

In some instances, a lot of contact lenses having slightly different correction D are prepared, and all of them are tested on a patient's cornea. In the instances, since one of the contact lenses is used for correction, while the others are discarded, there are problems that many lenses are wasted, and an increased burden is imposed on the patient.

[0007]

Since the number of doctors who specialize in vision correction treatment using orthokeratology lenses as described above is low

and the areas where such doctors are present are limited, the treatment imposes quite temporal and economic burdens on patients who live in distant locations. In the distant locations, even if the doctors are present, the doctors have technical and temporal difficulties in getting optimal orthokeratology lenses for the patients.

Citation List

Patent Literature

[0008]

Patent Literature 1: United States Patent No. 5695509

10 Patent Literature 2: Japanese Patent No. 3881221

Summary of Invention

Technical Problem

[0009]

The present invention has been made in view of the conventional problems described above, and an object of the present invention is to provide an orthokeratology lens designating method and an orthokeratology lens designating system that quickly designate an optimal contact lens for orthokeratology, i.e. orthokeratology lens, without the need to mount contact lenses on a patient's cornea again and again and impose a burden on the patient, and to provide an orthokeratology lens designating and supplying method and an orthokeratology lens designating and supplying system that designate and supply the orthokeratology lens.

Solution to Problem

25 [0010]

The present inventor has developed a method for easily finding out an orthokeratology lens that is optimally mounted on a patient's cornea. The present inventor has built a database that accumulates data about orthokeratology lenses actually used for correcting corneas of ten thousand or more patients, by using this method. The present inventor has made it possible to easily designate an optimal orthokeratology lens, on the basis of the database, from a patient's corneal data acquired by a doctor. Furthermore, data about the designated orthokeratology lens is transmitted to a terminal of the doctor, and is transmitted therefrom to a lens manufacturing device. The orthokeratology lens is then manufactured with the lens manufacturing device, and is supplied to the doctor.

[0011]

Namely, the above object is solved by the following embodiments.

[0012]

(1) An orthokeratology lens designating method includes a database building process of repeating a trial process in which a mounting process of mounting an orthokeratology lens on a cornea at a position centering on a pupil of a patient whose head is in an erect state, an image information acquiring process of continuously or intermittently acquiring images of the orthokeratology lens moving on the cornea, and a movement data detecting process of detecting a movement speed and a movement

direction of the orthokeratology lens from the acquired image information are sequentially performed on a plurality of orthokeratology lenses, and a selection process of determining whether or not data of the acquired movement speed and movement direction is within a certain range, and when the data is within the certain range, selecting a lens as the orthokeratology lens to be used for the patient in order to build a lens database, provided that the selected orthokeratology lens is assigned as a registered lens, by storing registered patient data that includes at least registered cornea D data, out of registered lens correction D data having lens correction D data of the registered lens at a contact portion with the cornea, the registered cornea D data having D data of the cornea at the contact portion before mounting the registered lens, registered corneal diameter data having corneal diameter data of the patient, and registered pupil diameter data having pupil diameter data of the patient, and registration stage data having data that indicates in which stage of a plurality of correction stages, including first, second, and later stages, the registered lens is mounted on the cornea;

a patient data acquiring process of acquiring patient data including at least patient cornea D data, out of the patient cornea D data having D data of a patient's cornea to be corrected, patient corneal diameter data having data of a corneal diameter, and patient pupil diameter data having data of a pupil diameter;

a patient stage data acquiring process of acquiring patient

stage data that indicates which stage of a plurality of correction stages the present mounting of an orthokeratology lens corresponds to, on the patient's cornea to be corrected; and

a lens designating process of retrieving the registered lens having the registered cornea D data that is the closest to the acquired patient cornea D data and the same registration stage data as the patient stage data in the lens database, and designating the retrieved registered lens as an orthokeratology lens to be used for the patient.
[0013]

(2) An orthokeratology lens designating system includes a selecting device, a database server, a lens designating server connected to the database server, and a terminal device that can be connected to the lens designating server,

the selecting device includes a lens movement data acquiring device that includes a lens imaging camera configured to image an orthokeratology lens mounted on a cornea at a position centering on a pupil of a patient whose head is in an erect state to continuously or intermittently acquire images of the orthokeratology lens moving on the cornea, and a lens movement data detecting device configured to detect lens movement data having data about at least a movement speed and a movement direction of the orthokeratology lens from the image information of the orthokeratology lens moving on the cornea acquired by the lens imaging camera; and an assessing device configured to determine whether or not the acquired lens movement data is within a certain range, and assess the orthokeratology lens

that is within the certain range as an orthokeratology lens suited for use for the patient,

the selecting device is configured such that, provided that the orthokeratology lens that is suited for use for the patient is assigned as a registered lens, registered lens correction D data having data of lens correction D of the registered lens at a contact portion with the cornea of the patient, registered patient data including at least registered cornea D data, out of the registered cornea D data having D data of the cornea to be corrected at the contact portion, registered corneal diameter data having corneal diameter data of the patient, and registered pupil diameter data, and registration stage data having data that indicates in which stage of a plurality of correction stages, including first, second, and later stages, the registered lens is mounted on the cornea are outputted to the database server,

the database server is configured to build a database by storing the registered patient data and the registration stage data on the registered lens,

the terminal device includes a patient data acquiring device configured to acquire patient data including at least patient cornea D data, out of the patient cornea D data having D data of a patient's cornea to be corrected, patient corneal diameter data having data of a corneal diameter, and patient pupil diameter data having data of a pupil diameter; and a patient stage data acquiring device configured to acquire patient stage data that indicates in which

stage of a plurality of correction stages, including first, second, and later stages, the next orthokeratology lens is mounted on the patient's cornea to be corrected, and the terminal device is configured to be capable of transmitting the patient data and the patient stage data to the lens designating server, and

the lens designating server is configured to retrieve the registered lens having the registered cornea D data that is the closest to the acquired patient cornea D data and the same registration stage data as the patient stage data in the database, and designate the retrieved registered lens as an orthokeratology lens to be used for the patient.

[0014]

(3) An orthokeratology lens designating and supplying method includes:

a database building process of repeating a trial process in which a mounting process of mounting an orthokeratology lens on a cornea at a position centering on a pupil of a patient whose head is in an erect state, an image information acquiring process of continuously or intermittently acquiring images of the orthokeratology lens moving on the cornea, and a movement data detecting process of detecting a movement speed and a movement direction of the orthokeratology lens from the acquired image information are sequentially performed on a plurality of orthokeratology lenses, and a selection process of determining whether or not data of the acquired movement speed and movement

direction is within a certain range, and when the data is within the certain range, selecting a lens as the orthokeratology lens to be used for the patient; in order to build a lens database, provided that the selected orthokeratology lens is assigned as a registered
5 lens, by storing registered patient data that includes at least registered cornea D data, out of registered lens correction D data having lens correction D data of the registered lens at a contact portion with the cornea, the registered cornea D data having D data of the cornea at the contact portion before mounting the registered
10 lens, registered corneal diameter data having corneal diameter data of the patient, and registered pupil diameter data having pupil diameter data of the patient, and registration stage data having data that indicates in which stage of a plurality of correction stages, including first, second, and later stages, the registered
15 lens is mounted on the cornea,

a patient data acquiring process of acquiring patient data including at least patient cornea D data, out of the patient cornea D data having D data of a patient's cornea to be corrected, patient corneal diameter data having data of a corneal diameter, and patient
20 pupil diameter data having data of a pupil diameter,

a patient stage data acquiring process of acquiring patient stage data that indicates which stage of a plurality of correction stages the present mounting of an orthokeratology lens corresponds to, on the patient's cornea to be corrected,

25 a lens designating process of retrieving the registered lens

having the registered cornea D data that is the closest to the acquired patient cornea D data and the same registration stage data as the patient stage data in the lens database, and designating the retrieved registered lens as an orthokeratology lens to be used for the patient,

5 a registered lens correction D data transmitting process of transmitting the registered lens correction D data of the designated orthokeratology lens to a lens manufacturing device, and

a lens manufacturing process of accepting the transmitted registered lens correction D data, and manufacturing the
10 orthokeratology lens to be used for the patient on the basis of the registered lens correction D data.

[0015]

(4) An orthokeratology lens designating and supplying system includes a selecting device, a database server, a lens designating
15 server connected to the database server, a terminal device that can be connected to the lens designating server, and a lens manufacturing device,

the selecting device includes a lens movement data acquiring device that includes a lens imaging camera configured to image an
20 orthokeratology lens mounted on a cornea at a position centering on a pupil of a patient whose head is in an erect state to continuously or intermittently acquire images of the orthokeratology lens moving on the cornea, and a lens movement data detecting device configured to detect lens movement data having data about at least a movement
25 speed and a movement direction of the orthokeratology lens from

image information of the orthokeratology lens moving on the cornea acquired by the lens imaging camera; and an assessing device configured to determine whether or not the acquired lens movement data is within a certain range, and assess the orthokeratology lens that is within the certain range as an orthokeratology lens suited for use for the patient,

the selecting device is configured such that, provided that the orthokeratology lens that is suited for use for the patient is assigned as a registered lens, registered lens correction D data having data of lens correction D of the registered lens at a contact portion with the cornea of the patient, registered patient data including at least registered cornea D data, out of the registered cornea D data having D data of the cornea to be corrected at the contact portion, registered corneal diameter data having corneal diameter data of the patient, and registered pupil diameter data, and registration stage data having data that indicates in which stage of a plurality of correction stages, including first, second, and later stages, the registered lens is mounted on the cornea are outputted to the database server,

the database server is configured to build a database by storing the registered patient data and the registration stage data on the registered lens,

the terminal device includes a patient data acquiring device configured to acquire patient data including at least patient cornea D data, out of the patient cornea D data having D data of a patient's

cornea to be corrected, patient corneal diameter data having data of a corneal diameter, and patient pupil diameter data having data of a pupil diameter; and a patient stage data acquiring device configured to acquire patient stage data that indicates in which
5 stage of the plurality of correction stages, including the first, second, and later stages, the next orthokeratology lens is mounted on the patient's cornea to be corrected, and the terminal device is configured to be capable of transmitting the patient data and the patient stage data to the lens designating server,

10 the lens designating server is configured to retrieve the registered lens having the registered cornea D data that is the closest to the acquired patient cornea D data and the same registration stage data as the patient stage data in the database, and to designate the retrieved registered lens as an orthokeratology lens to be used
15 for the patient, and

the lens manufacturing device is configured to manufacture the same lens as the registered lens, as an orthokeratology lens to be mounted on the patient, on the basis of the registered lens correction D data of the designated orthokeratology lens.

20 Advantageous Effects of Invention

[0016]

According to the present invention, on the basis of the patient data having the patient cornea D data of the patient's cornea and the patient stage data that indicates which stage of a plurality
25 of correction stages for the same patient the orthokeratology lens

is in, the registered lens data having similar data is retrieved in the lens database and the optimal orthokeratology lens can be designated and manufactured, thereby quickly supplying a doctor who is located at a distance with the optimal orthokeratology lens.

5 Thus, the present invention can have the effect of significantly reducing a load of a patient and the occurrence of waste lenses.

Brief Description of Drawings

[0017]

FIG. 1 is a block diagram showing a configuration of an
10 orthokeratology lens designating and supplying system according to an embodiment of the present invention;

FIG. 2 is a block diagram showing a configuration of a database server according to the embodiment;

FIG. 3 is a plan view schematically illustrating a movement
15 state of the orthokeratology lens mounted on a cornea of a patient;

FIG. 4A is an enlarged cross-sectional view schematically illustrating the relationship between patient cornea D based on patient data and lens correction D of the orthokeratology lens in the case of correcting myopia;

20 FIG. 4B is an enlarged cross-sectional view schematically illustrating the relationship between patient cornea D based on patient data and lens correction D of the orthokeratology lens in the case of correcting hyperopia or presbyopia;

FIG. 5 is a block diagram illustrating a configuration of a
25 lens designating server according to the embodiment;

FIG. 6 is a block diagram illustrating a configuration of a terminal device according to the embodiment;

FIG. 7 is a flowchart of a database building process using data acquired by a selecting device according to the embodiment;

5 FIG. 8 is a flowchart of an optimal orthokeratology lens designating and supplying process, on the basis of data from a database and data from the terminal device, in the orthokeratology lens designating server according to the present embodiment;

10 FIG. 9A is a graph showing a difference between cornea D data and lens correction D data, when calculating corrected lens correction D data;

FIG. 9B is a graph similar to FIG. 9A, in different conditions;

15 FIG. 10 is a flowchart of an orthokeratology lens designating process, when an estrangement between patient data and registered patient data is large; and

FIG. 11 is a flowchart of a subroutine of the process shown in FIG. 10.

Description of Embodiments

[0018]

20 An embodiment of the present invention will be described below in detail with reference to the drawings.

[Embodiment]

[0019]

25 As illustrated in FIG. 1, an orthokeratology lens designating and supplying system (hereinafter referred to as designating and

supplying system) 10 for orthokeratology according to an embodiment of the present invention is configured to include a selecting device 20, a database server 30, a lens designating server 50 as a main server, a lens manufacturing device 50C connected to the lens designating server 50, terminal devices 70 that can be connected to the lens designating server 50, and terminal side lens manufacturing devices 74.

[0020]

The correspondence relationship between the above-described respective configurations will be schematically described.

[0021]

In the selecting device 20 in the designating and supplying system 10 according to the embodiment, a lens movement data acquiring device 22 acquires data about a movement direction and a movement speed of an orthokeratology lens immediately after the orthokeratology lens is mounted on a patient's cornea. An assessing device 28 assesses whether or not the movement direction and the movement speed are optimal for the patient's cornea.

[0022]

The database server 30 is configured to build a database 30B (refer to FIG. 2) by repeating a process of storing data on an orthokeratology lens (registered lens) that is assessed to be usable (positive) and data on the patient's cornea.

[0023]

As illustrated in FIG. 1, the terminal devices 70 and the

terminal side lens manufacturing devices 74 are located at distances from the lens designating server 50, for example, beside doctors 72 who are abroad, at domestic distant locations, or the like. The terminal device 70 is configured to be capable of transmitting patient data, including patient cornea D data on a patient's cornea acquired by measurement by the doctor 72, to the lens designating server 50.

[0024]

The lens designating server 50 is configured to retrieve a registered lens having similar data to the received patient data in the database 30B of the database server 30, and designate the lens as an optimal orthokeratology lens.

[0025]

Upon designating the orthokeratology lens by the lens designating server 50, as illustrated in FIG. 1, lens data of the designated orthokeratology lens is transmitted to a lens data accepting and transmitting device 73 of the terminal device 70. The lens data accepting and transmitting device 73 outputs a manufacturing command signal, together with the lens data of the designated orthokeratology lens, to the terminal side lens manufacturing device 74. The terminal side lens manufacturing device 74 thereby manufactures an orthokeratology lens having the lens data. The doctor 72 acquires the manufactured orthokeratology lens, and uses the orthokeratology lens for the patient.

[0026]

When no orthokeratology lens is manufactured by the terminal side lens manufacturing device 74, the lens manufacturing device 50C manufactures an orthokeratology lens. The manufactured orthokeratology lens is sent by a lens dispatching agency 50D to the doctor 72 who controls and operates the terminal device 70 that has sent the patient data, and who will correct the patient's cornea using the orthokeratology lens.

[0027]

Table 1 shows the types of output data from the lens movement data acquiring device 22, data that is outputted from the selecting device 20 and stored in the database server 30, and data that is outputted from the terminal device 70 and inputted to the lens designating server 50.

[0028]

[Table 1]

Data from lens movement data acquiring device	Movement speed data	
	Movement direction data	
Registered lens data (database)	Registered lens correction D data	
	Registered lens movement data	
	Registration stage data	
	Registered patient data	Registered myopia or hyperopia data
		Registered cornea D data
		Registered corneal diameter data
		Registered pupil diameter data
Data from a terminal device	Patient data	Registered myopia or hyperopia data
		Registered cornea D data
		Registered corneal diameter data
		Registered pupil diameter data
	Patient stage data	

[0029]

A description will next be given of detailed individual devices

5 in the designating and supplying system 10 sequentially.

[0030]

As shown in FIG. 1, the selecting device 20 includes a patient data acquiring device 20B having a keratometer (not illustrated), the lens movement data acquiring device 22 having a lens imaging camera 24 and a lens movement data detecting device 26, and the assessing device 28. In FIG. 1, the reference numeral 20A indicates an IF means, the reference numeral 21A indicates a keyboard, the reference numeral 21B indicates a display, and the reference numeral

10

21C indicates a printer.

[0031]

The lens imaging camera 24 is configured to image an orthokeratology lens mounted on a cornea at a position centering
5 on a pupil of a patient whose head is in an erect state, to continuously or intermittently acquire images of the orthokeratology lens that is moving on the cornea.

[0032]

The lens movement data detecting device 26 is configured to
10 detect lens movement data, which includes data about at least a movement speed and a movement direction of the orthokeratology lens, from the images of the orthokeratology lens moving on the cornea, acquired by the lens imaging camera 24.

[0033]

15 The assessing device 28 determines whether or not the lens movement data acquired by the lens movement data acquiring device 22, including the lens movement data detecting device 26, is within a certain range. An orthokeratology lens the movement of which is within the certain range is assessed to be suited for use for the
20 patient.

[0034]

In the certain range, for example, as illustrated in FIG. 3, conditions that a movement speed is more than 0 and 10 mm/sec or less, and a movement direction V is within an angle θ of 6 degrees
25 or less rightward or leftward with respect to a normal P_e that extends

perpendicularly downward from a pupil Pu, are satisfied. In FIG. 3, the reference numeral O_{L0} represents the orthokeratology lens at the position of the pupil Pu, and the reference numeral O_{L1} represents the orthokeratology lens that has moved from the position of the pupil Pu to the V direction.

[0035]

An orthokeratology lens that has descended from the pupil position, while a patient is sleeping or waking, returns to the pupil position by blinking. However, when the above-described conditions are not satisfied, in other words, when the orthokeratology lens has descended too fast or too obliquely, the orthokeratology lens does not return to the pupil position by blinking. When the movement speed is 0, the orthokeratology lens that is in tight contact with a cornea causes a reduced oxygen supply to the cornea, and therefore the orthokeratology lens is not appropriate. The maximum movement speed of 10 mm/sec and the angle of 6 degrees are on the basis of treatment data of ten thousand or more patients given by the inventor.

[0036]

To the assessing device 28, stage data that represents whether an orthokeratology lens to be used for a patient is a first lens, which is mounted on a cornea in a first stage of a plurality of correction stages, or a second or later lens, which is put in a second or later stage, is inputted from, for example, the keyboard 21A.

[0037]

The selecting device 20 is configured to output, about an orthokeratology lens (registered lens) that is assessed to be suited for use for a patient, lens correction D data at a portion in contact with the patient's cornea, lens movement data, stage data, and patient data including myopia or hyperopia data that represents whether the orthokeratology lens is used for correction of myopia or hyperopia and presbyopia, cornea D data comprising cornea D data of the cornea to be corrected at the contact portion, corneal diameter data about a corneal diameter, and pupil diameter data about a pupil diameter to the database server 30.

[0038]

The database server 30 is configured to accumulate the inputted data about the orthokeratology lens, more specifically, the registered lens movement data, the registered lens correction D data, the registration stage data, and the registered patient data including the registered lens movement data, the registered myopia or hyperopia data, the registered cornea D data, the registered corneal diameter data, and the registered pupil diameter data as shown in, for example, Table 2, to build the database 30B.

[0039]

[Table 2]

Lens No.	Registered myopia or hyperopia data	Registered patient data			Registered lens correction D data		Registration stage data (Nth lens)
		Registered patient cornea diopter (D_r)	Registered corneal diameter (mm)	Registered pupil diameter (mm)	Diopter(D_R)		
10001	CLOSE	39.00	11.0	6.2	32.25		5
10002	CLOSE	39.30	10.8	6.4	34.10		2
10003	CLOSE	39.50	10.8	6.4	35.00		2
10004	CLOSE	40.05	10.8	6.4	33.75		4
10005	CLOSE	40.25	11.0	6.2	31.30		5
10006	CLOSE	40.40	10.8	6.4	32.90		4
10007	CLOSE	40.50	11.2	6.2	32.20		4
10008	CLOSE	40.50	11.2	6.6	32.25		3
10009	CLOSE	40.60	11.0	6.4	33.10		3
10010	CLOSE	41.10	11.2	6.2	33.80		4
10011	CLOSE	41.00	11.2	6.6	34.00		3
10012	CLOSE	41.00	11.0	6.4	34.70		3
10013	CLOSE	41.15	11.0	6.4	35.50		2
10014	CLOSE	41.20	10.8	6.2	36.00		2
10015	CLOSE	41.25	11.0	6.6	34.45		2
10016	CLOSE	41.30	10.8	6.0	35.70		2
10017	CLOSE	41.50	10.8	6.6	38.75		1
10018	CLOSE	41.75	10.8	6.6	39.50		1
10019	CLOSE	42.25	10.8	6.6	39.25		1
10020	CLOSE	42.50	10.8	6.4	39.25		1
13001	DISTANT	43.25	10.8	6.4	45.80		1
13002	DISTANT	43.50	10.8	6.4	47.50		1
13003	DISTANT	44.30	10.6	6.4	48.30		1
13004	DISTANT	45.00	10.6	6.4	48.60		1
13005	DISTANT	45.75	10.8	6.4	49.75		2
13006	DISTANT	45.80	10.6	6.4	49.00		1
13007	DISTANT	46.00	10.8	6.4	49.40		2
13008	DISTANT	46.25	10.6	6.4	49.25		1
13009	DISTANT	46.30	10.8	6.4	49.70		2
13010	DISTANT	46.45	10.8	6.4	49.60		2

[0040]

Since the radius R of curvature of a lens and the radius r of curvature of a cornea increase with a decrease in diopter (D), in the case of correcting myopia, as shown in FIG. 4A, the relationship of lens diopter D_R relative to corneal diopter D_r is $D_r > D_R$ i.e. $r < R$ holds true. In the case of correcting hyperopia or presbyopia, as shown in FIG. 4B, $D_r < D_R$ i.e. $r > R$ holds true. The difference

between D_r and D_R , i.e. $D_r - D_R$ or $D_R - D_r$, differs depending on which stage of the plurality of correction stages the lens is used in, and the difference is the largest in the first stage.

[0041]

5 More specifically, as shown in FIG. 2, the database server 30 is configured to include an IF means 30A, a control means 40, and the database 30B. In FIG. 2, the reference numeral 40A indicates a keyboard, the reference numeral 40B indicates a display, and the reference numeral 40C indicates a printer.

10 [0042]

The control means 40 is configured to include a registered lens correction D data accepting function 41, a registered lens movement data accepting function 42, a registration stage data accepting function 43, a registered patient data accepting function 44, and a registered cornea D and lens D difference data calculation means 45.

[0043]

The database 30B is configured to include a registered lens correction D data memory means 31, a registered lens movement data memory means 32, a registration stage data memory means 33, a registered patient data memory means 34, and a registration cornea D and lens D difference data memory means 35.

[0044]

In the present specification, for example, the registered lens correction D data accepting function 41 constitutes a registered

lens correction D data accepting means together with the IF means 30A. In other words, each function constitutes a means together with the IF means.

[0045]

5 The registered lens correction D data accepting function 41 of the database server 30 is configured to accept registered lens correction D data transmitted from the selecting device 20 through the IF means 30A. The accepted registered lens correction D data is stored in the registered lens correction D data memory means
10 31 of the database 30B.

[0046]

 In the same manner, registered lens movement data transmitted from the selecting device 20 is accepted by the registered lens movement data accepting function 42, and stored in the registered
15 lens movement data memory means 32. Registration stage data transmitted from the selecting device 20 is accepted by the registration stage data accepting function 43, and stored in the registration stage data memory means 33. Registered patient data is accepted by the registered patient data accepting function 44,
20 and stored in the registered patient data memory means 34. The registration cornea D and lens D difference data calculation means 45 is configured to calculate the difference between registered cornea D data and registered lens correction D data of the registered patient data. A calculated result value is stored in the registration
25 cornea D and lens D difference data memory means 35 as cornea D

and lens D difference data.

[0047]

A description will next be given of the lens designating server 50 shown in FIG. 5 in detail.

5 [0048]

The lens designating server 50 is configured to include an IF means 50A, a control means 60, and a memory device 50B. In FIG. 5, the reference numeral 60A indicates a keyboard, the reference numeral 60B indicates a display, and the reference numeral 60C indicates a printer.

[0049]

The control means 60 is configured to be capable of accepting a signal from the terminal device 70 through the Internet 14 and the IF means 50A as a response function of the control means 60.

15 [0050]

From the keyboard 60A, a signal is manually inputted to the control means 60 through the IF means 50A.

[0051]

The control means 60 is configured to include a terminal setting information accepting function 61, a patient data accepting function 62, a patient stage data accepting function 63, a lens imaging camera possession information accepting function 63A, a database retrieval means 64, a corrected lens correction D data calculation means 65, a corrected data lens designating means 66, a test lens data generation means 66A, a lens manufacturing command function 67, a designated

20

25

lens data request accepting and transmitting function 67A, a lens completion information accepting function 68, a lens return information accepting function 69, and a designated test lens data accepting function 69A.

5 [0052]

The memory device 50B is configured to include a terminal information memory means 51, a patient data memory means 52, a patient stage data memory means 53, a designated lens data request memory means 53A, a lens imaging camera possession information memory means 53B, a corrected lens correction D data memory means 54, a corrected data lens memory means 55, a test lens data memory means 55A, a designated lens memory means 56, a lens manufacturing command information memory means 57, a completed lens information memory means 58, a lens return information memory means 59, and a designated
10 test lens data memory means 59A.
15

[0053]

As shown in FIG. 6, the terminal device 70 includes a patient data acquiring device 71, a control device 80 having a patient data transmitting function 84, and a memory device 90. In FIG. 6, the
20 reference numeral 70A indicates an IF means, the reference numeral 80A indicates a keyboard, the reference numeral 80B indicates a display, and the reference numeral 80C indicates a printer.

[0054]

The control device 80 is configured to include a terminal
25 registration information transmitting function 81, a patient data

accepting function 82, a patient stage data accepting function 83,
the above-described patient data transmitting function 84, a patient
stage data transmitting function 85, a lens reception information
accepting function 86, a lens return information transmitting
5 function 87, a designated test lens information transmitting
function 88, and a lens data request transmitting function 89A,
a lens data accepting function 89B, and a lens data transmitting
function 89C that constitute the lens data accepting and transmitting
device 73 together with an IF means 70A.

10 [0055]

The memory device 90 is configured to include a terminal
registration information memory means 91, a patient data memory
means 92, a patient stage data memory means 93, a data transmission
memory means 94, a lens reception information memory means 95, a
15 lens return information memory means 96, a designated test lens
information memory means 97, and a lens data request information
memory means 98.

[0056]

The terminal device 70 is configured to transmit information
20 that the terminal device 70 is used by the contract doctor 72 and
the terminal registration information transmitting function 81 is
under the control of the doctor 72, to the lens designating server
50, which is a main server, together with a password and an ID.
This terminal registration information is registered in the terminal
25 registration information memory means 91 of the memory device 90.

The terminal registration information includes information of whether or not the terminal device 70 includes a lens imaging camera that is similar to the lens imaging camera 24 of the selecting device 20.

5 [0057]

The patient data accepting function 82 accepts patient data (patient data including patient cornea D data, corneal diameter, and pupil diameter) from the patient data acquiring device 71 through the IF means 70A. The accepted patient data is configured to be
10 stored in the patient data memory means 92. Note that, out of the patient data, patient myopia or hyperopia data is inputted from the keyboard 80A.

[0058]

Patient stage data is inputted from the keyboard 80A. The
15 patient stage data is accepted by the patient stage data accepting function 83 through the IF means 70A, and stored in the patient stage data memory means 93.

[0059]

The patient data transmitting function 84 is configured to
20 transmit the patient data stored in the patient data memory means 92 to the lens designating server 50 through the IF means 70A and the Internet 14, and also the patient stage data transmitting function 85 is configured to transmit the patient stage data stored in the patient stage data memory means 93 to the lens designating server
25 50 through the IF means 70A and the Internet 14. The data transmission

is stored in the data transmission memory means 94.

[0060]

The lens reception information accepting function 86 accepts an input of information about a reception of an orthokeratology lens by the doctor 72, through the keyboard 80A and the IF means 70A, by an operation of the doctor 72. The lens reception information is stored in the lens reception information memory means 95 of the memory device 90.

[0061]

The lens return information transmitting function 87 is configured to transmit information about a return of a lens, when the doctor 72 returns an orthokeratology lens that has been used for correcting a cornea in a completed correction stage to the lens dispatching agency 50D, on the basis of lens return information inputted from the keyboard 80A, to the lens designating server 50 through the IF means 70A and the Internet 14. The lens return information is stored in the lens return information memory means 96 of the memory device 90.

[0062]

The designated test lens information transmitting function 88 is configured to transmit information about a test lens that is designated to be optimal for use in treatment, after a plurality of test lenses (described later) that have been sent are tried on a patient, to the lens designating server 50. This information is stored in the designated test lens information memory means 97.

[0063]

The lens data request transmitting function 89A is configured to transmit a request signal to the lens designating server 50 when the doctor 72 requests lens data to manufacture an orthokeratology lens to be used for a patient. The lens data accepting function 89B is configured to transmit data of the designated orthokeratology lens, which is stored in the designated lens memory means 56, to the lens data accepting and transmitting device 73 through the IF means 50A.

[0064]

The patient data acquiring device 71 is configured to acquire patient data which includes patient cornea D data of a patient's cornea to be corrected, corneal diameter data, and pupil diameter data. The patient data transmitting function 84 is configured to be capable of transmitting the patient data to the lens designating server 50 through the Internet 14.

[0065]

More specifically, as the patient data acquiring device 71, Auto Kerato-Refractometer (KP-8100PA) manufactured by Topcon Corporation, Shin-Nippon (CT-1000) Corneal Topographer manufactured by, currently, Ajinomoto Trading, Inc., Pentacam Corneal Topographer manufactured by Oculuse, or the like is used.

[0066]

The lens designating server 50 is configured to retrieve a registered lens used for a cornea that has the same patient cornea

D data as or the closest patient cornea D data to the cornea in the database 30B, and designate the registered lens as an orthokeratology lens having a curvature suited for use for the patient.

5 [0067]

Next, a database building process and an orthokeratology lens designating process will be described with reference to FIGS. 7 and 8.

[0068]

10 In the database building process, as shown in step S101 of FIG. 7, an orthokeratology lens is mounted on a patient's cornea to be corrected. At this time, the orthokeratology lens is mounted at a position centering on a pupil of the patient whose head is in an erect state. Then, the orthokeratology lens descends by gravity
15 along a surface of the cornea. However, due to the relationship between a lens curvature of the orthokeratology lens and a corneal curvature of the cornea at a contact surface, the orthokeratology lens does not necessarily perpendicularly move downward, and its speed is not necessarily constant.

20 [0069]

The present inventor has found out that, when conditions that a movement speed is more than 0 and 10 mm/sec or less, and a movement direction is within an angle of 6 degrees rightward or leftward with respect to a downward perpendicular normal of the pupil are
25 satisfied as described above, the orthokeratology lens can be used

for correction of the cornea.

[0070]

Next, the process proceeds to step S102, and the lens imaging camera 24 images the orthokeratology lens mounted on the patient's cornea, to continuously or intermittently acquire images of the orthokeratology lens moving on the cornea. The process proceeds to step S103, and the lens movement data detecting device 26 acquires movement data, which includes a movement speed and a movement direction of the orthokeratology lens, from the image information acquired by the lens imaging camera 24.

[0071]

Next, in step S104, the assessing device 28 determines whether or not the acquired movement data is within a certain range. To be more specific, it is determined whether or not the movement speed is more than 0 and 10 mm/sec or less, and the movement direction has an angle of 6 degree or less with respect to a normal passing through the center of the patient's pupil.

[0072]

If a determination result is Yes, the process proceeds to the next step S105, and the orthokeratology lens is assessed to be a registered lens that can be used for correction of the cornea. If the determination result is No, the process proceeds to step S108.

[0073]

When the orthokeratology lens is assessed to be usable for treatment in step S105, in the next step S106, the orthokeratology

lens is assigned as a registered lens, and the assessing device 28 transmits registered lens correction D data, registered lens movement data, registration stage data, and registered patient data on the registered lens to the database server 30.

5 [0074]

In the database server 30, the registered lens correction D data accepting function 41, the registered lens movement data accepting function 42, the registration stage data accepting function 43, and the registered patient data accepting function 44 accept the transmitted data, and store the data in the registered lens correction D data memory means 31, the registered lens movement data memory means 32, the registration stage data memory means 33, and the registered patient data memory means 34, respectively. By repetitions of the above processes, the database 30B is built.

15 [0075]

Note that, in the control means 40 of the database server 30, the registration cornea D and lens D difference data calculation means 45 can calculate the difference between the patient cornea D data from the registered patient data and the lens correction D data of the orthokeratology lens to correct the patient's cornea, and a calculation result is stored in the registration cornea D and lens D difference data memory means 35 (refer to step S107).

[0076]

As described above, the process of mounting the orthokeratology lens on the patient's cornea, the process of assessing whether or

not the lens can be used, and the process of storing the assessed result in the database are repeated. If the next lens is absent in step S108, the database building process is completed. If the next lens is present, the process proceeds to step S109. The next orthokeratology lens is mounted, and the next steps S102 to S108 are repeated again.

[0077]

Next, a process of designating an orthokeratology lens that is optimal for correction for a patient by the lens designating server 50, using data stored in the database 30B of the database server 30, on the basis of data transmitted from the terminal device 70 will be described.

[0078]

As shown in FIG. 8, in step S201, in the terminal device 70, the patient data acquiring device 71 acquires patient data which includes patient cornea D data, a corneal diameter, and a pupil diameter of a patient who desires to correct his or her cornea. The patient data is transmitted to the lens designating server 50 through the Internet 14 (refer to step S202).

[0079]

At this time, a doctor 72 inputs from the keyboard 80A data that indicates which stage of a plurality of correction stages the present cornea correction is in, to the patient stage data accepting function 83 through the IF means 70A. When the doctor 72 requires lens data to manufacture an orthokeratology lens designated by the

lens designating server 50, lens data request information is inputted to the lens data request transmitting function 89A.

[0080]

Note that the patient data from the patient data acquiring device 71 is once accepted by the patient data accepting function 82 through the IF means 70A. The accepted patient data and patient stage data are stored in the patient data memory means 92 and the patient stage data memory means 93, respectively. The lens data request information is stored in the lens data request information memory means 98.

[0081]

The stored patient data and patient stage data are transmitted by the patient data transmitting function 84 and the patient stage data transmitting function 85 of the control device 80 of the terminal device 70 to the lens designating server 50 through the IF means 70A and the Internet 14, and also the lens data request information is transmitted by the lens data request transmitting function 89A thereof to the lens designating server 50 through the IF means 70A and the Internet 14.

[0082]

In the lens designating server 50, the patient data and the patient stage data are accepted by the patient data accepting function 62 and the patient stage data accepting function 63 of the control means 60 and stored in the patient data memory means 52 and the patient stage data memory means 53 of the memory device 50B,

respectively. The lens data request information is accepted by the designated lens data request accepting and transmitting function 67A, and stored in the designated lens data request memory means 53A of the memory device 50B. Furthermore, at the time of contracting with the doctor 72, if the doctor 72 has a lens imaging camera that is similar to the lens imaging camera 24, the information is inputted from the lens imaging camera possession information accepting function 63A, and stored in the lens imaging camera possession information memory means 53B.

10 [0083]

The process proceeds to step S203, the database retrieval means 64 of the lens designating server 50 retrieves a registered lens having data that is the same as or similar to the patient data and the patient stage data from the terminal device 70, in the database 30B of the database server 30, on the basis of the patient data, or both of the patient data and the patient stage data transmitted from the terminal device 70.

[0084]

The process proceeds to step S204, and it is determined that the difference between registered cornea D data of the retrieved registered lens and patient cornea D data of the patient data from the terminal device 70 is a certain value (for example, 0.03D) or less.

[0085]

25 If a determination result is Yes, the process proceeds to step

S205. The registered lens is stored in the designated lens memory means 56 as a designated lens.

[0086]

The above-described "difference" is 0.01 mm, i.e., a radius
5 of curvature of the cornea. This is because it is considered that
the detection accuracy limitation of a measurement device is 0.01
mm. Converting the radius of curvature into a diopter (D) in Table
3, 0.03D is acquired.

[0087]

10 [Table 3]

Dioptr (D)	mm	Dioptr (D)	mm	Dioptr (D)	mm	Dioptr (D)	mm
36.00	9.38	39.87	8.47	43.63	7.74	47.50	7.11
36.12	9.34	40.00	8.44	43.75	7.71	47.63	7.09
36.25	9.31	40.12	8.41	43.88	7.69	47.75	7.07
36.37	9.28	40.25	8.39	44.00	7.67	47.88	7.05
36.50	9.25	40.37	8.36	44.13	7.65	48.00	7.03
36.62	9.22	40.50	8.33	44.25	7.63	48.13	7.01
36.75	9.18	40.62	8.31	44.38	7.61	48.25	6.99
37.00	9.12	40.75	8.28	44.50	7.58	48.38	6.98
37.12	9.09	40.87	8.26	44.63	7.56	48.50	6.96
37.25	9.06	41.00	8.23	44.75	7.54	48.63	6.94
37.37	9.03	41.13	8.21	44.88	7.52	48.75	6.92
37.50	9.00	41.25	8.18	45.00	7.50	48.88	6.91
37.62	8.97	41.38	8.16	45.13	7.48	49.00	6.89
37.75	8.94	41.50	8.13	45.25	7.46	49.13	6.87
37.87	8.91	41.63	8.11	45.38	7.44	49.25	6.85
38.00	8.88	41.75	8.08	45.50	7.42	49.38	6.84
38.12	8.85	41.88	8.06	45.63	7.40	49.50	6.82
38.25	8.82	42.00	8.04	45.75	7.38	49.63	6.80
38.37	8.80	42.13	8.01	46.00	7.34	49.75	6.78
38.50	8.77	42.25	7.99	46.13	7.32	49.88	6.77
38.62	8.74	42.38	7.96	46.25	7.30	50.00	6.75
38.75	8.71	42.50	7.94	46.38	7.28	50.13	6.73
38.87	8.68	42.63	7.92	46.50	7.26	50.25	6.72
39.00	8.65	42.75	7.89	46.63	7.24	50.38	6.70
39.12	8.63	42.88	7.87	46.75	7.22	50.50	6.68
39.25	8.60	43.00	7.85	46.88	7.20	50.63	6.67
39.37	8.57	43.13	7.83	47.00	7.18	50.75	6.65
39.50	8.55	43.25	7.80	47.13	7.16		
39.62	8.52	43.38	7.78	47.25	7.14		
39.75	8.49	43.50	7.76	47.38	7.12		

[0088]

Note that, if there are a plurality of registered lenses, which is determined to be Yes, a registered lens having the closest registered corneal diameter data and registered pupil diameter data to the patient corneal diameter data and patient pupil diameter data, respectively, may be designated as a designated lens.

[0089]

The process proceeds from step S205 to step S205A, and it is determined whether or not a lens data request from the doctor is present. If No, the process proceeds to step S206.

[0090]

In step S206, a command signal (lens data) to produce an orthokeratology lens having the same data as the stored designated lens is transmitted to the lens manufacturing device 50C, and therefore the orthokeratology lens is produced thereby.

[0091]

If Yes in step S205A, in other words, if designated lens data request information is stored in the designated lens data request memory means 53A, the process proceeds to step S205B. A command signal is transmitted to the lens data accepting and transmitting device 73 of the terminal device 70 through the Internet 14. In step S205C, the command signal is transmitted from the lens data accepting and transmitting device 73 to the terminal side lens manufacturing device 74, and an orthokeratology lens is produced. In other words, the orthokeratology lens is produced in a distant

location and used for treatment.

[0092]

Note that, in the command signal, a diopter (D) of lens correction D data is converted into and outputted as a radius (mm) of curvature of a lens, with the use of a diopter-to-millimeter conversion table shown in Table 3.

[0093]

The lens manufacturing device 50C and the terminal side lens manufacturing device 74 are devices that manufacture orthokeratology lenses on the basis of received data, and may be a normal cutting type contact lens manufacturing device or a 3D printer. The terminal side lens manufacturing device 74 is located by the doctor 72 or in a lens maker that has a cooperative relationship with the doctor 72, while the lens manufacturing device 50C is located in the vicinity of the lens designating server 50.

[0094]

In step S207, the produced orthokeratology lens is directly provided to the doctor 72 or is supplied to the doctor 72 from the lens maker. Furthermore, when lens data is not requested, the orthokeratology lens is sent to the doctor 72 who manages the terminal device 70, through the lens dispatching agency 50D.

[0095]

If the determination result is No in step S204, the process proceeds to step S208. Steps S208 to S210 are performed as follows by the corrected lens correction D data calculation means 65 of

the control means 60 of the lens designating server 50.

[0096]

First, in step S208, as shown in FIGS. 9A and 9B, when the registered lens having data that is the closest to the cornea D data is assigned as a first lens, and the registered lens having data that is the second closest thereto is assigned as a second lens, the difference in cornea D data between first registered cornea D data r_1 of the first lens and second registered cornea D data r_2 of the second lens, i.e. $r_1 - r_2 = \Delta C$, is calculated. In the next step S209, when the registered lens correction D data of the first lens and the second lens is assigned as R_1 and R_2 , respectively, the difference in registered lens correction D data, i.e., $R_1 - R_2 = \Delta L$, is calculated.

[0097]

In step S210, the product of the difference Δr_1 between the patient cornea D data r_0 of the patient data and the registered cornea D data r_1 of the first lens and $\Delta L / \Delta C$ is obtained. The product is added to or subtracted from the registered lens correction D data R_1 of the first lens, to calculate corrected lens correction D data.

[0098]

In other words, lens correction D per unit cornea D is calculated. Multiplying the lens correction D by $r_0 - r_1 = \Delta r_1$ results in a lens correction D value (difference) corresponding to the difference between r_0 and r_1 , and D_0 is obtained by adding R_1 to this. For example, as shown in FIG. 9A, when $r_0 > r_1 > r_2$ and $R_1 > R_2$, $D_0 = (r_0 - r_1 =$

$\Delta r_1) \times \Delta L / \Delta C + R_1$. When $r_1 > r_0 > r_2$ and $R_1 > R_0 > R_2$, as shown in FIG. 9B, $D_0 = R_1 - \Delta r_1 \times \Delta L / \Delta C$.

[0099]

In the next step S211, it is determined whether or not the
5 above-described ΔL is a certain value or less, in other words, whether
or not the difference between the registered lens correction D data
of the first lens and that of the second lens is not too large.
If the difference is too large, the corrected lens correction D
data has low reliability. If the determination result is Yes, the
10 process proceeds to step S212. If No, the process proceeds to a
subroutine (B: FIG. 10).

[0100]

In step S212, the corrected data lens designating means 66
designates a corrected orthokeratology lens having the corrected
15 lens correction D data, which is calculated as described above,
as a designated lens, and data of the designated lens is added to
the database 30B, as indicated by symbol A in FIGS. 7 and 8. Next,
the process returns to step S205, and the designated lens is stored
in the memory device 50B. Next, in step S205A, the presence or absence
20 of a lens data request is determined.

[0101]

The corrected lens correction D data, the corrected data lens,
and the designated lens may be stored in the corrected lens correction
D data memory means 54, the corrected data lens memory means 55,
25 and the designated lens memory means 56 of the memory device 50B,

respectively, and may build a part of the database.

[0102]

If the determination result is Yes in step S205A, an orthokeratology lens is supplied through the above-described steps S205B and S205C. If No, the process proceeds to step S213.

[0103]

In step S213, the lens manufacturing command function 67 of the lens designating server 50 transmits a command signal to produce a corrected lens having the corrected lens correction D data, which is calculated as described above, to the lens manufacturing device 50C. The corrected lens is produced in step S213, and the process proceeds to step S207. In step S207, the corrected lens is sent from the lens dispatching agency 50D to the doctor 72.

[0104]

Next, a case in which the determination result is No in step S211 will be described.

[0105]

In this case, as indicated by symbol B, the process proceeds to step S301 shown in FIG. 10.

[0106]

In step S301, the test lens data generation means 66A calculates production data for a plurality of test lenses.

[0107]

Provided that $\Delta L/m = \alpha L$ and m is an integer of $3 \leq m \leq 10$, m types of values, i.e., m types of correction D in which each of

α_L , $2\alpha_L$, $\dots$ and $m\alpha_L$ is added to the corrected lens correction D (corrected lens correction D + α_L , corrected lens correction D + $2\alpha_L$, $\dots$ corrected lens correction D + $m\alpha_L$), and m types of values, i.e., m types of correction D in which each of α_L , $2\alpha_L$, $\dots$ and $m\alpha_L$ is subtracted from the corrected lens correction D (corrected lens correction D - α_L , corrected lens correction D - $2\alpha_L$, $\dots$ corrected lens correction D - $m\alpha_L$) are calculated.

[0108]

Next, in step S302, the presence or absence of a lens data request is determined. If No, the process proceeds from symbol D to the subroutine of FIG. 11. If Yes, the process proceeds to step S303, and test lens data having the $2m$ types of correction D is transmitted to the terminal device 70.

[0109]

In the next step S304, the test lens data is transmitted from the terminal device 70 to the terminal side lens manufacturing device 74, and test lenses are manufactured.

[0110]

In step S305, the doctor 72 puts the test lens on a patient's eye.

[0111]

In the next step S306, the doctor 72 determines whether or not the terminal device 70 has a lens imaging camera that is similar to the lens imaging camera 24 of FIG. 1. If Yes, the process proceeds to step S307, and the lens imaging camera captures an image of the

test lens mounted on the patient.

[0112]

The process proceeds to step S308, and movement data of the test lens is acquired from the image captured as described above.

5 In the next step S309, the movement data is transmitted from the terminal device 70 to the assessing device 28 of the selecting device 20 through the Internet 14.

[0113]

The process proceeds to step S310, data of an optimal test
10 lens that is selected by the assessing device 28 is added to the database 30B, as an orthokeratology lens to be used for treatment, together with the patient data, by returning to the routine of FIG. 7 as indicated by symbol A.

[0114]

15 To be more specific, the data of the selected orthokeratology lens to be used for treatment is transmitted from the terminal device 70 to the lens designating server 50. The data is accepted by the designated test lens data accepting function 69A of the lens designating server 50, and stored in the designated test lens data
20 memory means 59A. The data of the orthokeratology lens to be used for treatment is transmitted from the lens designating server 50 to the control means 40 of the database server 30 (refer to FIG. 10 and symbol A of FIG. 7), together with the patient data, so that the data is added to the database 30B as registered lens data and
25 registered patient data.

[0115]

In step S311, the data of the optimal test lens is transmitted to the terminal device 70, and the doctor 72 uses a test lens having the transmitted data for the patient.

5 [0116]

If No in step S306, as indicated by symbol E, the process proceeds to step S310. Data of an optimal test lens that is selected by decision of the doctor 72 as an orthokeratology lens to be used for treatment is added to the database 30B, together with the patient data, and
10 the optimal test lens is used for the patient in step S312, through step S311.

[0117]

Next, the determination result is No in step S302, as shown in symbol D, the process proceeds to step S401 in the subroutine
15 of FIG. 11. Step S401 is the same as step S301 of FIG. 10.

[0118]

In the next step S402, test lenses having the calculated 2m types of correction D are produced with the lens manufacturing device
50C.

20 [0119]

The process proceeds to step S403, the manufactured test lenses are sent to the doctor 72. In step S404, the doctor 72 puts the test lenses on the patient, to designate an optimal test lens to be used for treatment.

25 [0120]

In the next step S405, data of the orthokeratology lens to be used for treatment is transmitted from the terminal device 70 to the lens designating server 50.

[0121]

5 The process proceeds to the next step S406, the data of the orthokeratology lens to be used for treatment is added to the database 30B, together with the patient data.

[0122]

10 Note that, according to clinical trials of the present inventor, 6 to 10 types of test lenses are sufficient as test lenses having the 2m types of correction D.

[0123]

15 The above-described designating and supplying system 10 includes the lens manufacturing device 50C and the terminal side lens manufacturing device 74, but the present invention is not limited thereto. The present invention may include a case in which the designating and supplying system 10 has only one of the lens manufacturing device 50C and the terminal side lens manufacturing device 74.

20 [0124]

 The present invention is applied to both of a case in which the lens imaging camera 24 is included as a part of the terminal device 70 and a case in which the lens imaging camera 24 is not included.

25 Industrial Applicability

[0125]

The present invention can be used for designating and manufacturing an orthokeratology lens for correcting a cornea, with a reduced patient's load.

5 Reference Signs List

[0126]

10 ... orthokeratology lens designating and supplying system
(designating and supplying system)

14 ... the Internet

10 20 ... selecting device

20A ... IF means

20B ... patient data acquiring device

21A, 40A, 60A, 80A ... keyboard

21B, 40B, 60B, 80B ... display

15 21C, 40C, 60C, 80C ... printer

22 ... lens movement data acquiring device

24 ... lens imaging camera

26 ... lens movement data detecting device

28 ... assessing device

20 30 ... database server

30A ... IF means

30B ... database

31 ... registered lens correction D data memory means

32 ... registered lens movement data memory means

25 33 ... registration stage data memory means

34 ... registered patient data memory means

35 ... registration cornea D and lens D difference data memory
means

40 ... control means

5 41 ... registered lens correction D data accepting function

42 ... registered lens movement data accepting function

43 ... registration stage data accepting function

44 ... registered patient data accepting function

45 ... registration cornea D and lens D difference data

10 calculation means

50 ... lens designating server

50A ... IF means

50B, 90 ... memory device

50C ... lens manufacturing device

15 50D ... lens dispatching agency

51 ... terminal information memory means

52 ... patient data memory means

53 ... patient stage data memory means

53A ... designated lens data request memory means

20 53B... lens imaging camera possession information memory means

54 ... corrected lens correction D data memory means

55 ... corrected data lens memory means

55A ... test lens data memory means

56 ... designated lens memory means

25 57 ... lens manufacturing command information memory means

58 ... completed lens information memory means

59 ... lens return information memory means

59A ... designated test lens data memory means

60 ... control means

5 61 ... terminal setting information accepting function

62 ... patient data accepting function

63 ... patient stage data accepting function

63A ... lens imaging camera possession information accepting
function

10 64 ... database retrieval means

65 ... corrected lens correction D data calculation means

66 ... corrected data lens designating means

66A ... test lens data generation means

67 ... lens manufacturing command function

15 67A... designated lens data request accepting and transmitting
function

68 ... lens completion information accepting function

69 ... lens return information accepting function

69A ... designated test lens data accepting function

20 70 ... terminal device

70A ... IF means

71 ... patient data acquiring device

72 ... doctor

73 ... lens data accepting and transmitting device

25 74 ... terminal side lens manufacturing device

80 ... control device

81... terminal registration information transmitting function

82 ... patient data accepting function

83 ... patient stage data accepting function

5 84 ... patient data transmitting function

85 ... patient stage data transmitting function

86 ... lens reception information accepting function

87 ... lens return information transmitting function

88 ... designated test lens information transmitting function

10 89A ... lens data request transmitting function

89B ... lens data accepting function

89C ... lens data transmitting function

91 ... terminal registration information memory means

92 ... patient data memory means

15 93 ... patient stage data memory means

94 ... data transmission memory means

95 ... lens reception information memory means

96 ... lens return information memory means

97 ... designated test lens information memory means

20 98 ... lens data request information memory means

CLAIMS

1. An orthokeratology lens designating method comprising
a database building process of repeating a trial process in
which a mounting process of mounting an orthokeratology lens on
a cornea at a position centering on a pupil of a patient whose head
5 is in an erect state, an image information acquiring process of
continuously or intermittently acquiring images of the
orthokeratology lens moving on the cornea, and a movement data
detecting process of detecting a movement speed and a movement
10 direction of the orthokeratology lens from the acquired image
information are sequentially performed on a plurality of
orthokeratology lenses, and a selection process of determining
whether or not data of the acquired movement speed and movement
direction is within a certain range, and when the data is within
15 the certain range, selecting a lens as the orthokeratology lens
to be used for the patient in order to build a lens database, provided
that the selected orthokeratology lens is assigned as a registered
lens, by storing registered patient data that includes at least
registered cornea D data, out of registered lens correction D data
20 having lens correction D data of the registered lens at a contact
portion with the cornea, the registered cornea D data having D data
of the cornea at the contact portion before mounting the registered
lens, registered corneal diameter data having corneal diameter data
of the patient, and registered pupil diameter data having pupil
25 diameter data of the patient, and registration stage data having

data that indicates in which stage of a plurality of correction stages, including first, second, and later stages, the registered lens is mounted on the cornea;

a patient data acquiring process of acquiring patient data including at least patient cornea D data, out of the patient cornea D data having D data of a patient's cornea to be corrected, patient corneal diameter data having data of a corneal diameter, and patient pupil diameter data having data of a pupil diameter;

a patient stage data acquiring process of acquiring patient stage data that indicates which stage of a plurality of correction stages the present mounting of an orthokeratology lens corresponds to, on the patient's cornea to be corrected; and

a lens designating process of retrieving the registered lens having the registered cornea D data that is the closest to the acquired patient cornea D data and the same registration stage data as the patient stage data in the lens database, and designating the retrieved registered lens as an orthokeratology lens to be used for the patient.

2. The orthokeratology lens designating method according to claim 1, wherein

the registered patient data in the database building process has registered myopia or hyperopia data that has data representing whether the registered lens is used for correction of myopia or hyperopia and presbyopia,

the patient data in the patient data acquiring process has patient myopia or hyperopia data that has data representing whether

the lens is used for correction of myopia or hyperopia and presbyopia,
and

the lens designating process retrieves the registered lens
having the registered cornea D data that is the closest to the acquired
5 patient cornea D data and the same registered myopia or hyperopia
data and the same registration stage data as the registered myopia
or hyperopia data and the patient stage data in the lens database,
respectively and designates the retrieved registered lens as an
orthokeratology lens to be used for the patient.

10 3. The orthokeratology lens designating method according to claim
1 or 2, wherein

in the selection process in the database building process,
when conditions that the movement speed is more than 0 and 10 mm/sec
or less, and the movement direction is within an angle of 6 degrees
15 or less rightward or leftward with respect to a normal that extends
perpendicularly downward from a pupil, are satisfied, the lens is
selected as the orthokeratology lens to be used for the patient.

4. The orthokeratology lens designating method according to any
one of claims 1 to 3, wherein

20 in the database building process, the lens database is built
by storing cornea D and lens D difference data that is a difference
between patient cornea D data of the cornea before mounting the
orthokeratology lens and the registered lens correction D data of
the mounted orthokeratology lens.

25 5. The orthokeratology lens designating method according to any

one of claims 1 to 4, wherein

in the lens designating process, when a difference between the acquired patient cornea D data and the closest registered cornea D data is a certain value or more,

5 the retrieved registered lens is assigned as a first lens, and the registered lens having the registered cornea D data that is the second closest to the acquired patient cornea D data is assigned as a second lens, and the registered cornea D data and the registered lens correction D data are assigned as first cornea D data and first
10 lens correction D data in the first lens, and are assigned as second cornea D data and second lens correction D data in the second lens, and

a lens D difference per unit cornea D is calculated by a ratio between cornea D difference data between the first cornea D data
15 and the second cornea D data and lens correction D difference data between the first lens correction D data and the second lens correction D data,

corrected lens D data is calculated by adding or subtracting a product of the lens D difference and a difference between the
20 patient cornea D data in the acquired patient data and the first cornea D data to or from the first lens correction D data, and

the orthokeratology lens having this corrected lens D data is designated as the orthokeratology lens to be used for the patient.

6. The orthokeratology lens designating method according to claim
25 5, comprising:

a process of calculating, when the lens D difference ΔL between the first lens correction D data and the second lens correction D data is a certain value or more, values of m types of correction D in which each of αL , $2\alpha L$, $\dots$ and $m\alpha L$ is added to the corrected lens D data, and m types of correction D in which each of αL , $2\alpha L$, $\dots$ and $m\alpha L$ is subtracted from the corrected lens D data provided that $\Delta L/m = \alpha L$ and m is an integer of $3 \leq m \leq 10$;

a process of producing test lenses having the respective two m types of correction D; and

10 a process of trying the two m types of test lenses on the patient to designate the optimal test lens as the orthokeratology lens for use in treatment.

7. The orthokeratology lens designating method according to claim 5 or 6, wherein

15 in the database building process, the lens D data, the patient data, and the stage data about the orthokeratology lens designated on a basis of the lens D difference is stored to build the lens database.

8. The orthokeratology lens designating method according to claim 20 5, comprising:

a lens manufacturing process of manufacturing a corrected orthokeratology lens on a basis of the corrected lens D data.

9. An orthokeratology lens designating and supplying method comprising, in any of claims 1 to 8,

25 a registered lens correction D data transmitting process of

transmitting the registered lens correction D data of the designated orthokeratology lens to a lens manufacturing device, and

a lens manufacturing process of accepting the transmitted registered lens correction D data, and manufacturing the

5 orthokeratology lens to be used for the patient on the basis of the registered lens correction D data.

10. The orthokeratology lens designating and supplying method according to claim 9, comprising

a patient data transmitting process of transmitting the patient
10 data and the patient stage data acquired in the patient data acquiring process and the patient stage data acquiring process, to a lens designating server that executes the lens designating process through the Internet.

11. The orthokeratology lens designating and supplying method
15 according to claim 9, wherein

the lens manufacturing process comprises:

a process of receiving the registered lens correction D data transmitted in the registered lens correction D data transmitting process by a terminal device that executes the patient data acquiring
20 process; and

a registered lens correction D data transmitting process of transmitting the received registered lens correction D data to the lens manufacturing device.

12. The orthokeratology lens designating and supplying method
25 according to claim 10, wherein

in the registered lens correction D data transmitting process,
the registered lens correction D data is transmitted to the lens
manufacturing device directly or through the Internet from the lens
designating server and the manufactured orthokeratology lens is
5 sent for the patient.

13. The orthokeratology lens designating and supplying method
according to claim 9, comprising

a test lens data transmitting process of transmitting test
lens data having the two m types of correction D to the lens
10 manufacturing device, and

a test lens manufacturing process of manufacturing a test lens
by the lens manufacturing device on a basis of the transmitted test
lens data.

14. An orthokeratology lens designating system comprising a
15 selecting device, a database server, a lens designating server
connected to the database server, and a terminal device that can
be connected to the lens designating server,

the selecting device includes a lens movement data acquiring
device that includes a lens imaging camera configured to image an
20 orthokeratology lens mounted on a cornea at a position centering
on a pupil of a patient whose head is in an erect state to continuously
or intermittently acquire images of the orthokeratology lens moving
on the cornea, and a lens movement data detecting device configured
to detect lens movement data having data about at least a movement
25 speed and a movement direction of the orthokeratology lens from

image information of the orthokeratology lens moving on the cornea acquired by the lens imaging camera; and an assessing device configured to determine whether or not the acquired lens movement data is within a certain range, and assess the orthokeratology lens
5 that is within the certain range as an orthokeratology lens suited for use for the patient,

the selecting device is configured such that, provided that the orthokeratology lens that is suited for use for the patient is assigned as a registered lens, registered lens correction D data
10 having data of lens correction D of the registered lens at a contact portion with the cornea of the patient, registered patient data including at least registered cornea D data, out of the registered cornea D data having D data of the cornea to be corrected at the contact portion, registered corneal diameter data having corneal
15 diameter data of the patient, and registered pupil diameter data, and registration stage data having data that indicates in which stage of a plurality of correction stages, including first, second, and later stages, the registered lens is mounted on the cornea are outputted to the database server,

20 the database server is configured to build a database by storing the registered patient data and the registration stage data on the registered lens,

the terminal device includes a patient data acquiring device configured to acquire patient data including at least patient cornea
25 D data, out of the patient cornea D data having D data of a patient's

cornea to be corrected, patient corneal diameter data having data of a corneal diameter, and patient pupil diameter data having data of a pupil diameter, and a patient stage data acquiring device configured to acquire patient stage data that indicates in which
5 stage of the plurality of correction stages, including the first, second, and later stages, the next orthokeratology lens is mounted on the patient's cornea to be corrected, and the terminal device is configured to be capable of transmitting the patient data and the patient stage data to the lens designating server, and

10 the lens designating server is configured to retrieve the registered lens having the registered cornea D data that is the closest to the acquired patient cornea D data and the same registration stage data as the patient stage data in the database, and designate the retrieved registered lens as an orthokeratology lens to be used
15 for the patient.

15. The orthokeratology lens designating system according to claim 14, wherein

the selecting device is configured to output registered myopia or hyperopia data that has data representing whether the registered
20 lens is used for correction of myopia or hyperopia and presbyopia, to the database server,

the database server is configured to build a database by storing the registered myopia or hyperopia data,

the terminal device is configured to be capable of transmitting
25 patient myopia or hyperopia data that has data representing whether

the lens is used for correction of myopia or hyperopia and presbyopia,
to the lens designating server, and

the lens designating server is configured to retrieve the
registered lens having the registered cornea D data that is the
5 closest to the acquired patient cornea D data, the same registered
myopia or hyperopia data as the acquired patient myopia or hyperopia
data, and the same registration stage data as the acquired patient
stage data from the database, and designate the retrieved registered
lens as an orthokeratology lens to be used for the patient.

10 16. The orthokeratology lens designating system according to claim
15, wherein

when conditions that the movement speed is more than 0 and
10 mm/sec or less, and the movement direction is within an angle
of 6 degrees or less rightward or leftward with respect to a normal
15 that extends perpendicularly downward from a pupil, are satisfied,
the assessing device is configured to select the lens as the
orthokeratology lens to be used for the patient.

17. The orthokeratology lens designating system according to claim
15 or 16, wherein

20 the database server is configured to build a lens database
by storing cornea D and lens D difference data that is a difference
between patient cornea D data of the cornea before mounting the
orthokeratology lens and the registered lens correction D data of
the mounted orthokeratology lens.

25 18. The orthokeratology lens designating system according to any

one of claims 15 to 17, wherein

the lens designating server is configured,

when a difference between the acquired patient cornea D data
and the registered cornea D data closest thereto is a certain value

5 or more,

to assign the retrieved registered lens as a first lens, and
the registered lens having the registered cornea D data that is
the second closest to the patient cornea D data in the acquired
patient data as a second lens,

10 to assign the registered cornea D data and the registered lens
correction D data as first cornea D data and first lens correction
D data in the first lens, and as second cornea D data and second
lens correction D data in the second lens, and

to calculate a lens correction D difference per unit cornea
15 correction D data difference by a ratio between cornea D difference
data between the first cornea D data and the second cornea D data
and lens correction D difference data between the first lens
correction D data and the second lens correction D data,

to calculate corrected lens correction D data by adding or
20 subtracting a product of the lens correction D difference and a
difference between the patient cornea D data in the acquired patient
data and the first cornea D data to or from the first lens correction
D data, and

to designate the orthokeratology lens having this corrected
25 lens correction D data as the orthokeratology lens to be used for

the patient.

19. The orthokeratology lens designating system according to claim 18, wherein

the lens designating server is configured to calculate, when
5 the lens D difference ΔL between the first lens correction D data and the second lens correction D data is a certain value or more, values of m types of correction D in which each of αL , $2\alpha L$, ... and $m\alpha L$ is added to the corrected lens correction D, and m types of correction D in which each of αL , $2\alpha L$, ... and $m\alpha L$ is subtracted from
10 the corrected lens correction D provided that $\Delta L/m = \alpha L$ and m is an integer of $3 \leq m \leq 10$, and to output data for manufacturing test lenses having the respective two m types of correction D.

20. The orthokeratology lens designating system according to claim 18, wherein

15 the database server is configured to build the lens database by storing the corrected lens correction D data, the patient data, and the patient stage data about the orthokeratology lens designated on a basis of the lens correction D difference data as the registered lens correction D data, registered patient data, and registered
20 stage data, respectively.

21. The orthokeratology lens designating system according to any one of claims 15 to 20, wherein

the lens movement data detecting device is an image analysis device, and the selecting device is a central controlling device
25 that stores data of allowable values for the movement speed and

the movement direction in advance.

22. An orthokeratology lens designating and supplying system, in any of claims 14 to 21, further comprising a lens manufacturing device, wherein

5 the lens manufacturing device is configured to manufacture the same orthokeratology lens to be mounted on the patient as the registered lens, on a basis of the registered lens correction D data of the designated orthokeratology lens.

23. The orthokeratology lens designating and supplying system
10 according to claim 22, wherein

the terminal device includes a lens data accepting and transmitting device configured to accept the registered lens correction D data of the registered lens corresponding to the designated orthokeratology lens transmitted from the lens
15 designating server, and to output the accepted registered lens correction D data to the lens manufacturing device.

24. The orthokeratology lens designating and supplying system according to claim 23, wherein

the lens manufacturing device is annexed to the terminal
20 device.

25. The orthokeratology lens designating and supplying system according to claim 24, wherein

the terminal device includes a lens data request transmitting function that requests the lens designating server to send the lens
25 data of the registered lens designated as the orthokeratology lens

to the terminal device.

26. The orthokeratology lens designating and supplying system according to claim 22, wherein

the lens manufacturing device is configured to accept directly
5 or through the Internet the registered lens correction D data from
the lens designating server.

27. The orthokeratology lens designating and supplying system according to claim 19, wherein

the lens designating server is configured to send the data
10 for manufacturing test lenses having the respectively two m types
of correction D to the lens manufacturing device.