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16. Abstract

This study describes a new three-dimensional anatomical axis system based on four conventional anthropometrical face landmarks. Coincident as a coordinate (orthogonal) axis system, this reference system was developed to provide convenient orientation of the head segment and any surface landmark in three-dimensional space for direct comparisons with subject populations. Forty-four anthropometric landmarks on the face and adjacent areas are defined and measured on 30 adult female and male test subjects participating in a study to evaluate protective breathing equipment. These data provide a basic data base for test subject selections, dimensional correlations of face types with equipment performance, and preliminary design criteria (gross structure dimensions) for dummy test devices and protective-type breathing equipment. Individual sets of data points for each subject are presented in tabular format for the convenience of data use. These data describe only a mid-range adult population and do not represent the dimensional range or combinations of facial characteristics typical of children or older adults.

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THREE-DIMENSIONAL ANTHROPOMETRY OF THE ADULT FACE

INTRODUCTION

There is a continuous need for developing human-like mechanical devices for use in safety design and performance testing in aircraft and automobiles. These devices should have more realistic human characteristics that can be faithfully reproduced in size, shape, mass, and performance than those currently available. A greater realism requires a greater complexity in defining some of these characteristics in real three-dimensional space with known dimensional relationships to other body structures.

Basic to this three-dimensional concept is the establishment of a coordinate axis system that defines and interrelates all points and surface areas of the body and provides reliable descriptors of all measurable points of interest. A major goal of this study is the standardization of all dimensional relationships from one head-face segment to another by establishing a three-dimensional anatomical axis system that is, in effect, coincident with the basic coordinate or orthogonal axis reference system.

Although there are limited, lineal (point-to-point distance) type dimensions of the human face and head that have been obtained for specific design use and sample population descriptions, there are few three-dimensional data available and inadequate facial feature descriptors to establish a meaningful size-shape range of civil aircraft user populations for mask-type equipment design and evaluation. The 30 adult male and female subjects measured in this study were specifically selected because they have had extensive testing time with oxygen mask-type equipment and reasonably match the population range (Figures 1 and 2) of total face height (Sellion-Menton distance) and total face breadth (Bizygomatic distance) for military and civilian anthropometry studies (1,2,3,4,5). A correlation analysis of these dimensional data and physiological test results will be conducted in support of the current Civil Aeromedical Institute (CAMI) oxygen mask evaluation program.

ANATOMICAL AXIS SYSTEM

Unlike conventional surface anthropometry that describes a point-to-point relationship of limited boyd features and is not necessarily dimensionally relatable to other body structures, a three-dimensional anthropometry requires a convenient fixed-origin coordinate axis system that provides a known spatial relationship with all defined surface points.

The coordinate or orthogonal axis system (Figure 3) used in this study was established by the criteria of availability, convenience, and reliability of anatomical landmarks (subcutaneous or surface) that could be identified superficially on the face and related structures of the head. The directional assignment of these descriptive axes is also compatible with those axes conventionally used to describe basic anatomical sectioning planes, positions, and orientations in space. There is only one major difference in the relationship of conventional anatomical orientation of the face and head in space relative to the midsagittal plane. The traditional Frankfort Plane and set of defining landmarks are not used to describe or orient the head in any spatial relationship.

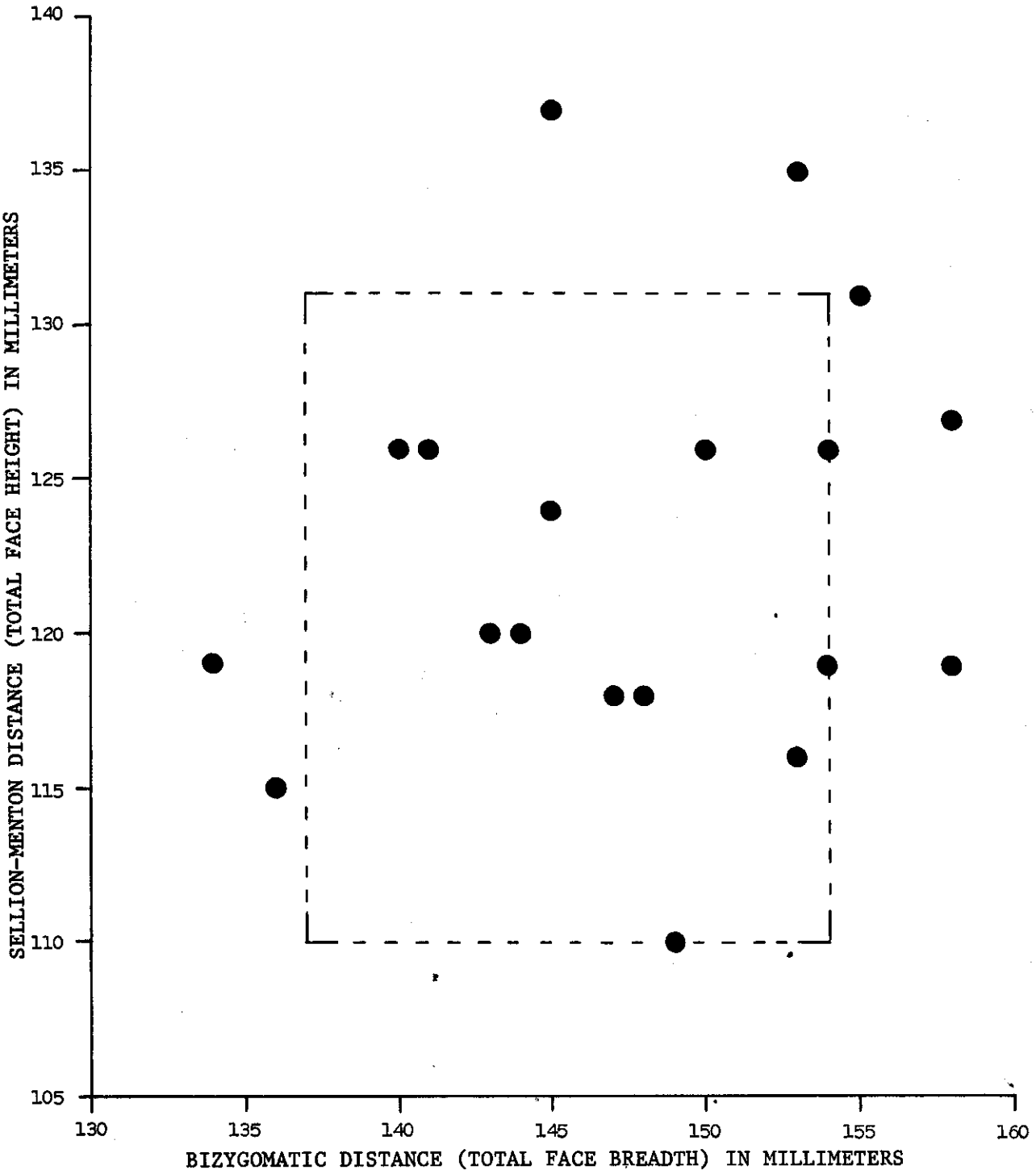

FIGURE 1. Comparative distribution of male subjects for this study. The estimated limits of combinations of 5th and 95th percentile face dimensions of composite military anthropometry are indicated by broken line.

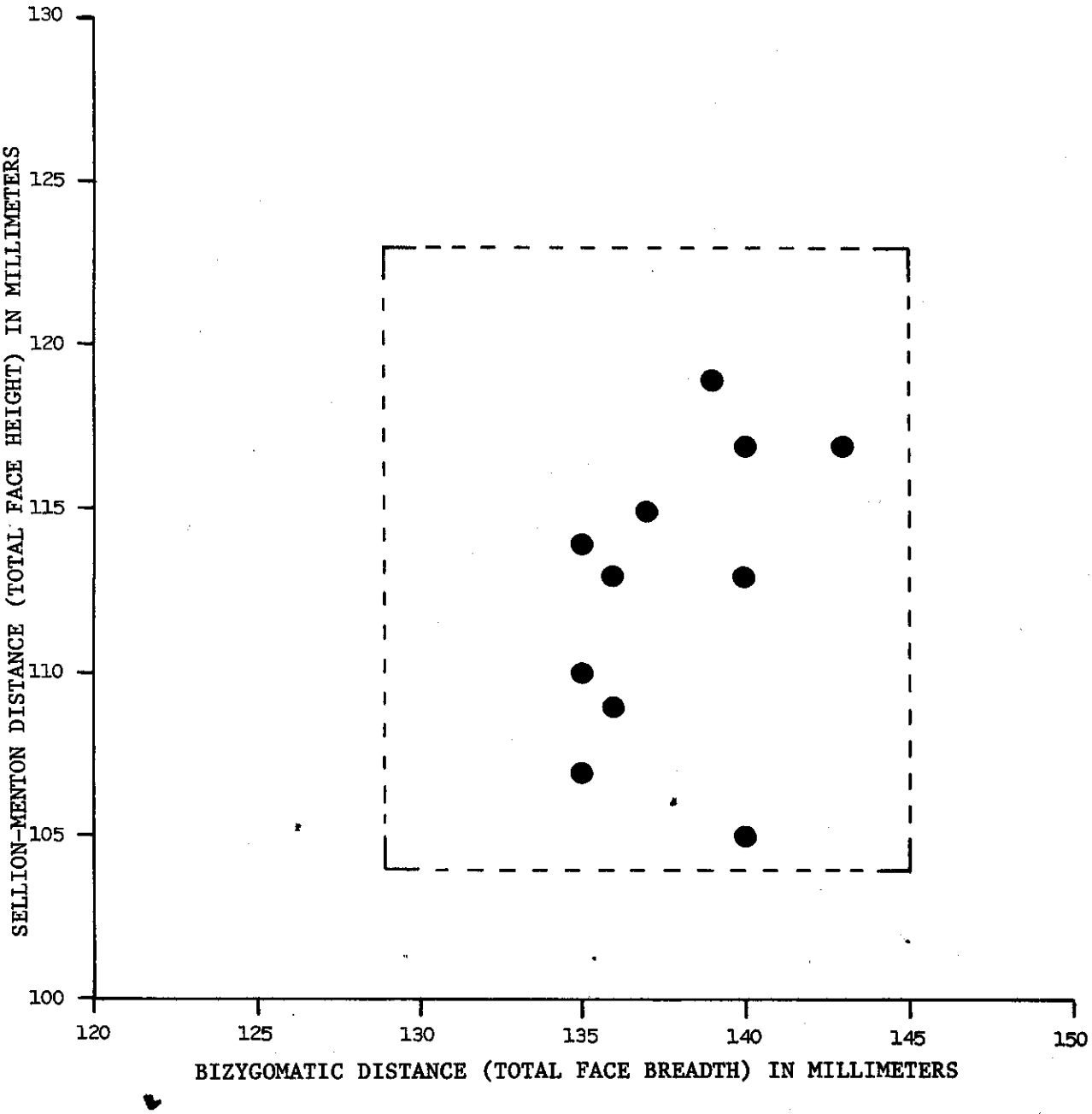

FIGURE 2. Comparative distribution of female subjects for this study. The estimated limits of combinations of 5th and 95th percentile face dimensions of composite military and civilian aircrew anthropometry are indicated by broken line.

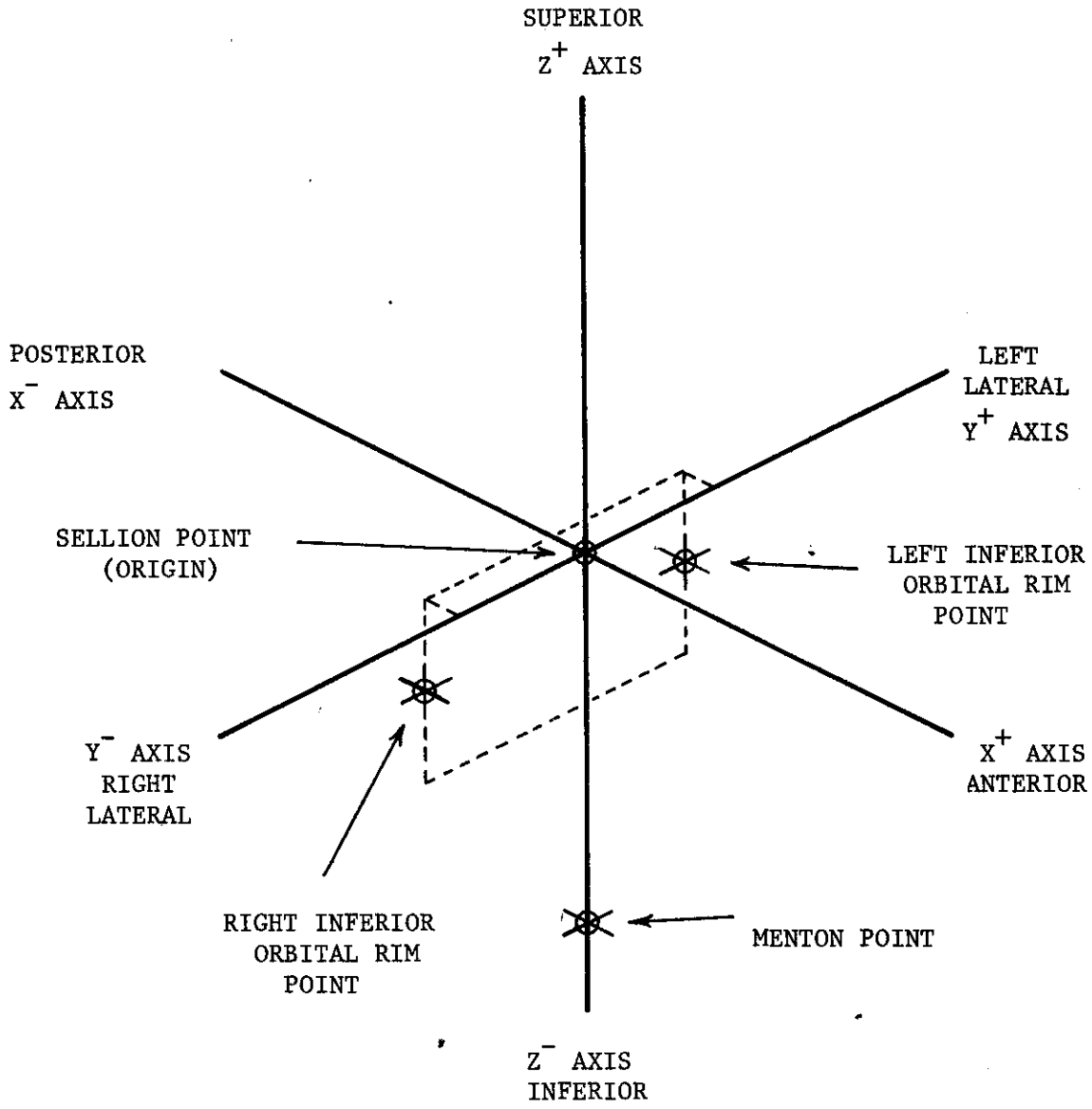

FIGURE 3. Anatomical axis system and face-head orientation landmarks for three-dimensional anthropometry.

The origin point for this orthogonal axis intersect is Sellion Point located in the nasal root depression. Points Sellion and Menton establish the "Z" axis (superior-inferior) for the face-head segment regardless of position or orientation relative to other body segments or external references. The "Y" axis (bilateral left to right) intersects Sellion (origin point) at right angles and is parallel to a coronal plane which intersects both left and right Inferior Orbital Rim points and is perpendicular to the "Z" axis. The "X" axis (anterior-posterior) intersects origin point Sellion and is perpendicular to both the "Z" and "Y" axes. The resulting anatomical planes formed by these axes are (1) the X-Z plane as the midsagittal plane, (2) the Y-Z plane as a coronal plane, and (3) the X-Y plane as a transverse plane. Since, by definition, the constructed midsagittal plane was the result of using both Inferior Orbital Rim points to establish the "Y" axis orientation, it may not be coincident with the classically defined anatomical midsagittal plane. In the axis system defined, all data points are expressed as a set of coordinate values by directional signs from Sellion Point (0,0,0) to each of the eight quadrants.

ANTHROPOMETRY METHODS

The selection criteria for reference landmarks are based primarily on those features or structures of the face that are accessible and reliably identified, and that adequately describe those surface areas related to equipment design. Some of these landmarks are classical standards and the others are modified with new definitions or are original for this study. All landmarks were identified by small ink dots, unless structurally superficial and plainly visible, and measured without distortion from tissue compression or facial expressions, with the subject's eyes opened and teeth in normal occlusion.

For the convenience and accuracy of measuring procedures with this particular equipment and to assure head stability, each subject was placed in an extended supine position. The posterior surfaces of the head and neck were supported in a contoured cradle elevated above the computer plotter board and adjusted for comfort. In this face-up position, all landmarks were accessible for placement of the height gauge pointer. Except for those landmarks located in the midsagittal plane, all other landmarks were identified and measured bilaterally as right side and left side as follows:

Bilateral Landmarks

Lateral Canthus Point - the lateral junction of the eyelids.

Medial Canthus Point - the medial junction of the eyelids.

Chelion Point - the lateral junction of the lips.

Gonion Point - the most lateral point in an area at the gonial angle of the mandible.

Superior Nose Base Point - a point located at the beginning of the anterior projection of maxillary bone that forms the nasal bridge (frontal process of the maxillary bone) and the intersection with the fronto-maxillary suture. In the living this point lies in the narrow depression immediately medial and superior to the Medial Canthus.

Middle Nose Base Point - the most lateral point at the beginning of the anterior projection of maxillary bone forming the nasal bridge. Typically, this point is approximately half the vertical distance between the Superior Nose Base Point and Inferior Nose Base Point.

Inferior Nose Base Point - the most lateral point at the intersection of the nasal ala and the cheek.

Lateral Orbital Rim Point - the most lateral point along the zygomatic frontal suture line.

Inferior Orbital Rim Point - a point along the inferior orbital margin that intersects a parasagittal plane passing through the eye pupil center.

Superior Orbital Rim Point - a point along the superior orbital margin that intersects a parasagittal plane bisecting the eye pupil.

Tragion Point - the most anterior point in the notch superior to the tragus of the ear.

Lateral Zygomatic Arch Point - the most lateral point on the zygomatic arch surface.

Midsagittal Landmarks

Menton Point - the most anterior-inferior point on the chin that intersects the midsagittal plane.

Promenton Point - the most anterior point on the chin projection in the midsagittal plane.

Infradentale Point - a point along the chin crease that intersects the midsagittal plane.

Stomion Point - a point at the intersect of the interlip line and equidistant from the bilateral chelion points.

Subnasale Point - a point at the median intersect of the nose septum and philtrum.

Pronasale Point - the most anterior point on the nose tip.

Midnasale Point - a point equidistant from Sellion Point and Pronasale Point along the most anterior-superior aspect of the nose.

Sellion Point - the deepest point in the indentation between the forehead and nose bridge in the midsagittal plane. This is the origin point for the head-face axis system used in this study.

Glabella Point - the most anterior point along the supraorbital ridge in the midsagittal plane.

Frontal Point(s) - this series of points is aligned vertically in the midsagittal plane on the forehead at 1-cm intervals above the Glabella Point.

Sets of data points for each of the 30 measured subjects are presented in the appendix as individual tabular format listings of the coordinate values for all three axes. Since these data are not intended to describe a comprehensive population sample, it is useful to examine each set of subject data as unique combinations of size and shape. This, of course, cannot be done with only summarized data statistics that do not describe the real and unique dimensional combinations of anatomical features. The user of these data may reconstruct a variety of actual dimensional combinations as profile plots or establish comparative dimensional frequency relationships for particular needs or interest.

THREE-DIMENSIONAL MEASURING SYSTEM

The basic measuring system consists of a Hewlett-Packard (HP) 9820 calculator with interconnecting HP 9864A digitizer and X-Y digitizer board, an HP 5300B measuring system counter, and a custom-made variable resistance transducer height gauge. The calculator is programmed to establish the orientation of a subject's anatomical axis system by entering (measuring) the four axis origin points in sequence. On command all data coordinate point values are stored, the three-dimensional points are rotated in the proper axis alignment, and a final data tape listing is printed. The measurements were taken by adjusting the height gauge pointer to each surface landmark in sequence and instructing the calculator to enter the pointer position.

SUMMARY

Forty-four anthropometric landmarks on the face and adjacent areas were measured by a three-dimensional technique on 30 adult females and males. These subjects were selected because of their participation in a concurrent program to evaluate protective breathing equipment that would provide known performance data for correlation with the three-dimensional anthropometry. The range of gross face size in breadth and height for both female and male subjects is reasonably consistent with the size range of sex groups estimated from military and civilian populations (Figures 1 and 2).

A new practical anatomical axis system to describe three-dimensional relationships of facial anthropometry and definitions for new data points have been established for use in future comprehensive data surveys. Individual sets of data points for each of the 30 subjects are presented in tabular format for the convenience of data use.

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APPENDIX A

Anthropometry

Table 1. Three-Dimensional Data Points Of Female Subject F-05
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 18	- 46	- 14	- 15	+ 46	- 13
Medial Canthus	- 11	- 16	- 13	- 11	+ 19	- 12
Chelion	- 7	- 25	- 72	- 6	+ 26	- 71
Gonion	- 61	- 60	- 81	- 52	+ 57	- 88
Superior Nose Base	- 10	- 13	- 11	- 10	+ 16	- 9
Middle Nose Base	- 3	- 15	- 27	- 5	+ 18	- 26
Inferior Nose Base	- 3	- 18	- 44	- 1	+ 17	- 43
Superior Nose Bridge	- 3	- 9	- 5	- 4	+ 12	- 3
Middle Nose Bridge	+ 5	- 9	- 22	+ 3	+ 13	- 23
Inferior Nose Bridge	+ 11	- 14	- 41	+ 14	+ 7	- 38
Superior Orbital Rim	- 7	- 31	+ 7	- 7	+ 34	+ 8
Lateral Orbital Rim	- 33	- 60	- 14	- 29	+ 61	- 13
Inferior Orbital Rim	- 11	- 31	- 23	- 11	+ 34	- 20
Tragion	- 82	- 68	- 33	- 80	+ 73	- 30
Lateral Zygomatic Arch	- 58	- 69	- 26	- 52	+ 71	- 26

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 105
Promenton	+ 4	0	- 95
Supramentale	0	0	- 85
Stomion	+ 7	- 2	- 71
Subnasale	+ 11	- 3	- 54
Pronasale	+ 27	- 5	- 39
Midnasale	+ 12	- 2	- 18
Sellion	0	0	0
Glabella	- 1	0	+ 14
Frontal +1	- 3	0	+ 27
Frontal +2	- 7	0	+ 37
Frontal +3	- 10	0	+ 47
Frontal +4	- 18	0	+ 57

Table 2. Three-Dimensional Data Points Of Female Subject F-20
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 18	- 46	- 14	- 16	+ 45	- 13
Medial Canthus	- 12	- 16	- 12	- 11	+ 16	- 13
Chelion	- 9	- 27	- 70	- 8	+ 26	- 71
Gonion	- 61	- 59	- 80	- 57	+ 57	- 83
Superior Nose Base	- 10	- 12	- 11	- 10	+ 12	- 10
Middle Nose Base	+ 2	- 9	- 23	+ 2	+ 11	- 22
Inferior Nose Base	0	- 18	- 42	- 1	+ 19	- 41
Superior Nose Bridge	- 3	- 8	- 5	- 4	+ 10	- 5
Middle Nose Bridge	+ 2	- 9	- 23	+ 2	+ 11	- 22
Inferior Nose Bridge	+ 10	- 14	- 41	+ 9	+ 15	- 40
Superior Orbital Rim	- 7	- 31	+ 7	- 7	+ 30	+ 8
Lateral Orbital Rim	- 32	- 59	- 13	- 29	+ 58	- 14
Inferior Orbital Rim	- 13	- 31	- 22	- 13	+ 30	- 20
Tragion	- 85	- 67	- 31	- 83	+ 68	- 30
Lateral Zygomatic Arch	- 57	- 67	- 25	- 53	+ 68	- 26

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 107
Promenton	+ 4	0	- 95
Supramentale	+ 2	0	- 85
Stomion	+ 5	0	- 70
Subnasale	+ 8	0	- 51
Pronasale	+ 26	+ 2	- 39
Midnasale	+ 9	+ 1	- 19
Sellion	0	0	0
Glabella	+ 2	0	+ 11
Frontal +1	+ 1	0	+ 23
Frontal +2	- 3	0	+ 33
Frontal +3	- 6	0	+ 42
Frontal +4	- 10	0	+ 51
Frontal +5	- 18	0	+ 57

Table 3. Three-Dimensional Data Points Of Female Subject F-17
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 24	- 47	- 14	- 25	+ 48	- 16
Medial Canthus	- 16	- 16	- 15	- 15	+ 15	- 14
Chelion	- 10	- 26	- 72	- 11	+ 25	- 70
Gonion	- 66	- 58	- 82	- 68	+ 56	- 85
Superior Nose Base	- 13	- 13	- 13	- 14	+ 13	- 11
Middle Nose Base	- 6	- 18	- 26	- 7	+ 19	- 28
Inferior Nose Base	- 4	- 19	- 42	- 7	+ 17	- 41
Superior Nose Bridge	- 6	- 10	- 8	- 5	+ 9	- 5
Middle Nose Bridge	+ 3	- 10	- 23	+ 1	+ 11	- 25
Inferior Nose Bridge	+ 13	- 13	- 39	+ 11	+ 13	- 38
Superior Orbital Rim	- 8	- 33	+ 6	- 8	+ 29	+ 6
Lateral Orbital Rim	- 34	- 56	- 15	- 33	+ 55	- 17
Inferior Orbital Rim	- 15	- 33	- 24	- 15	+ 29	- 23
Tragion	- 96	- 67	- 39	- 95	+ 68	- 41
Lateral Zygomatic Arch	- 61	- 68	- 31	- 63	+ 68	- 26

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 109
Promenton	+ 5	0	- 98
Supramentale	+ 1	0	- 85
Stomion	+ 3	0	- 69
Subnasale	+ 7	0	- 50
Pronasale	+ 22	0	- 37
Midnasale	+ 11	0	- 21
Sellion	0	0	0
Glabella	0	0	+ 10
Frontal +1	- 2	0	+ 21
Frontal +2	- 4	0	+ 31
Frontal +3	- 7	0	+ 42
Frontal +4	- 11	0	+ 50
Frontal +5	- 18	0	+ 60

Table 4. Three-Dimensional Data Points Of Female Subject F-13
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 16	- 48	- 11	- 15	+ 45	- 10
Medial Canthus	- 9	- 16	- 12	- 8	+ 15	- 11
Chelion	+ 1	- 26	- 73	- 2	+ 24	- 71
Gonion	- 61	- 57	- 86	- 63	+ 54	- 83
Superior Nose Base	- 8	- 13	- 9	- 8	+ 12	- 7
Middle Nose Base	- 3	- 19	- 26	- 2	+ 18	- 24
Inferior Nose Base	+ 1	- 19	- 46	+ 1	+ 16	- 42
Superior Nose Bridge	- 2	- 8	- 6	- 2	+ 8	- 5
Middle Nose Bridge	+ 4	- 12	- 23	+ 6	+ 9	- 20
Inferior Nose Bridge	+ 14	- 16	- 40	+ 16	+ 12	- 37
Superior Orbital Rim	- 1	- 32	+ 13	- 1	+ 30	+ 15
Lateral Orbital Rim	- 30	- 59	- 8	- 28	+ 55	- 9
Inferior Orbital Rim	- 7	- 32	- 22	- 7	+ 30	- 20
Tragion	- 88	- 71	- 27	- 88	+ 68	- 29
Lateral Zygomatic Arch	- 56	- 69	- 16	- 52	+ 66	- 12

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 110
Promenton	+ 10	0	- 97
Supramentale	+ 6	0	- 86
Stomion	+ 13	- 3	- 70
Subnasale	+ 12	- 3	- 50
Pronasale	+ 26	- 3	- 39
Midnasale	+ 11	- 2	- 19
Sellion	0	0	0
Glabella	+ 4	0	+ 19
Frontal +1	+ 3	0	+ 22
Frontal +2	0	0	+ 32
Frontal +3	- 4	0	+ 42
Frontal +4	- 8	0	+ 51
Frontal +5	- 15	0	+ 62

Table 5. Three-Dimensional Data Points Of Female Subject F-02
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 22	- 47	- 14	- 23	+ 48	- 12
Medial Canthus	- 12	- 13	- 13	- 13	+ 20	- 10
Chelion	- 6	- 25	- 73	- 3	+ 31	- 71
Gonion	- 80	- 56	- 88	- 76	+ 61	- 81
Superior Nose Base	- 12	- 10	- 10	- 12	+ 17	- 7
Middle Nose Base	- 4	- 17	- 30	- 3	+ 22	- 26
Inferior Nose Base	- 1	- 16	- 42	- 1	+ 24	- 40
Superior Nose Bridge	- 5	- 8	- 4	- 3	+ 14	- 2
Middle Nose Bridge	+ 4	- 9	- 25	+ 7	+ 16	- 21
Inferior Nose Bridge	+ 15	- 10	- 38	+ 14	+ 14	- 36
Superior Orbital Rim	- 8	- 29	+ 4	- 10	+ 32	+ 7
Lateral Orbital Rim	- 34	- 55	- 12	- 32	+ 56	- 12
Inferior Orbital Rim	- 14	- 29	- 23	- 14	+ 32	- 20
Tragion	- 96	- 71	- 32	- 95	+ 71	- 31
Lateral Zygomatic Arch	- 62	- 69	- 26	- 66	+ 71	- 23

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 113
Promenton	+ 7	0	- 103
Supramentale	+ 4	0	- 90
Stomion	+ 11	0	- 71
Subnasale	+ 12	0	- 50
Pronasale	+ 27	0	- 35
Midnasale	+ 14	0	- 17
Sellion	0	0	0
Glabella	0	0	+ 13
Frontal +1	- 3	0	+ 26
Frontal +2	- 7	0	+ 35
Frontal +3	- 10	0	+ 44
Frontal +4	- 15	0	+ 53
Frontal +5	- 20	0	+ 61

Table 6. Three-Dimensional Data Points Of Female Subject F-04
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 18	- 43	- 13	- 15	+ 45	- 9
Medial Canthus	- 10	- 13	- 13	- 10	+ 17	- 7
Chelion	- 2	- 21	- 77	- 1	+ 22	- 70
Gonion	- 61	- 53	- 90	- 57	+ 57	- 88
Superior Nose Base	- 9	- 10	- 7	- 10	+ 14	- 3
Middle Nose Base	- 4	- 14	- 28	- 5	+ 17	- 23
Inferior Nose Base	- 3	- 16	- 48	+ 1	+ 16	- 41
Superior Nose Bridge	- 2	- 5	- 2	- 3	+ 11	- 3
Middle Nose Bridge	+ 5	- 8	- 25	+ 5	+ 9	- 19
Inferior Nose Bridge	+ 13	- 8	- 44	+ 15	+ 10	- 40
Superior Orbital Rim	- 8	- 27	+ 10	- 9	+ 31	+ 14
Lateral Orbital Rim	- 32	- 54	- 8	- 34	+ 58	- 6
Inferior Orbital Rim	- 9	- 27	- 25	- 9	+ 31	- 17
Tragion	- 89	- 70	- 34	- 85	+ 69	- 33
Lateral Zygomatic Arch	- 54	- 67	- 27	- 51	+ 68	- 21

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 114
Promenton	+ 7	0	- 102
Supramentale	+ 3	0	- 90
Stomion	+ 10	+ 2	- 73
Subnasale	+ 12	+ 2	- 54
Pronasale	+ 29	+ 3	- 41
Midnasale	+ 14	+ 1	- 18
Sellion	0	0	0
Glabella	- 3	0	+ 20
Frontal +1	- 8	0	+ 36
Frontal +2	- 12	0	+ 43
Frontal +3	- 17	0	+ 51
Frontal +4	- 23	0	+ 59
Frontal +5	- 29	0	+ 65

Table 7. Three-Dimensional Data Points Of Female Subject F-08
(millimeters)

Bilateral Landmarks	Right Lateral			Left Lateral		
	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 24	- 44	- 9	- 20	+ 48	- 8
Medial Canthus	- 15	- 12	- 12	- 14	+ 15	- 10
Chelion	- 8	- 23	- 72	- 10	+ 31	- 71
Gonion	- 61	- 57	- 92	- 68	+ 61	- 92
Superior Nose Base	- 12	- 9	- 12	- 13	+ 11	- 10
Middle Nose Base	- 4	- 14	- 25	- 4	+ 18	- 23
Inferior Nose Base	- 1	- 15	- 43	- 2	+ 20	- 38
Superior Nose Bridge	- 3	- 5	- 7	- 4	+ 9	- 5
Middle Nose Bridge	+ 4	- 7	- 21	+ 2	+ 11	- 20
Inferior Nose Bridge	+ 16	- 10	- 37	+ 15	+ 16	- 35
Superior Orbital Rim	- 5	- 26	+ 8	- 7	+ 32	+ 10
Lateral Orbital Rim	- 38	- 56	- 7	- 35	+ 59	- 6
Inferior Orbital Rim	- 12	- 26	- 21	- 12	+ 32	- 18
Tragion	- 92	- 70	- 25	- 93	+ 72	- 27
Lateral Zygomatic Arch	- 24	- 44	- 9	- 20	+ 48	- 8

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 115
Promenton	+ 8	0	- 97
Supramentale	+ 6	0	- 87
Stomion	+ 11	+ 2	- 69
Subnasale	+ 14	+ 2	- 48
Pronasale	+ 25	+ 2	- 34
Midnasale	+ 9	+ 1	- 18
Sellion	0	0	0
Glabella	0	0	+ 10
Frontal +1	- 3	0	+ 21
Frontal +2	- 7	0	+ 30
Frontal +3	- 10	0	+ 38
Frontal +4	- 14	0	+ 47
Frontal +5	- 20	0	+ 57

Table 8. Three-Dimensional Data Points Of Female Subject F-03
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 20	- 52	- 9	- 17	+ 51	- 10
Medial Canthus	- 10	- 17	- 10	- 10	+ 18	- 7
Chelion	- 2	- 26	- 74	+ 1	+ 26	- 71
Gonion	- 71	- 57	- 86	- 70	+ 60	- 84
Superior Nose Base	- 10	- 12	- 6	- 7	+ 15	- 4
Middle Nose Base	- 2	- 18	- 25	0	+ 17	- 22
Inferior Nose Base	0	- 20	- 43	+ 1	+ 18	- 42
Superior Nose Bridge	- 3	- 7	- 2	- 4	+ 10	0
Middle Nose Bridge	+ 7	- 10	- 22	+ 8	+ 9	- 20
Inferior Nose Bridge	+ 14	- 12	- 41	+ 16	+ 9	- 39
Superior Orbital Rim	- 7	- 34	+ 11	- 7	+ 37	+ 13
Lateral Orbital Rim	- 33	- 62	- 6	- 30	+ 63	- 7
Inferior Orbital Rim	- 10	- 34	- 21	- 10	+ 37	- 18
Tragion	- 92	- 70	- 25	- 87	+ 75	- 27
Lateral Zygomatic Arch	- 61	- 70	- 23	- 59	+ 73	- 19

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 117
Promenton	+ 8	0	- 104
Supramentale	+ 7	0	- 88
Stomion	+ 12	- 2	- 72
Subnasale	+ 15	- 2	- 54
Pronasale	+ 29	- 2	- 40
Midnasale	+ 15	- 3	- 20
Sellion	0	0	0
Glabella	+ 2	0	+ 19
Frontal +1	- 1	0	+ 33
Frontal +2	- 3	0	+ 43
Frontal +3	- 7	0	+ 53
Frontal +4	- 12	0	+ 62
Frontal +5			

Table 9. Three-Dimensional Data Points Of Female Subject F-15
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 26	- 50	- 17	- 22	+ 48	- 19
Medial Canthus	- 14	- 17	- 17	- 15	+ 15	- 16
Chelion	- 9	- 26	- 78	- 8	+ 26	- 77
Gonion	- 72	- 56	- 92	- 63	+ 58	- 98
Superior Nose Base	- 15	- 13	- 13	- 14	+ 11	- 11
Middle Nose Base	- 6	- 19	- 31	- 5	+ 16	- 29
Inferior Nose Base	- 3	- 18	- 50	- 3	+ 17	- 48
Superior Nose Bridge	- 6	- 11	- 6	- 6	+ 9	- 3
Middle Nose Bridge	+ 5	- 12	- 27	+ 3	+ 10	- 25
Inferior Nose Bridge	+ 16	- 15	- 45	+ 14	+ 12	- 43
Superior Orbital Rim	- 10	- 30	+ 6	- 10	+ 31	+ 9
Lateral Orbital Rim	- 39	- 60	- 15	- 34	+ 60	- 16
Inferior Orbital Rim	- 12	- 30	- 27	- 12	+ 31	- 28
Tragion	- 100	- 71	- 33	- 94	+ 74	- 37
Lateral Zygomatic Arch	- 63	- 69	- 25	- 59	+ 71	- 29

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 117
Promenton	+ 7	0	- 107
Supramentale	+ 1	0	- 95
Stomion	+ 7	- 2	- 77
Subnasale	+ 11	- 1	- 54
Pronasale	+ 28	0	- 43
Midnasale	+ 17	- 2	- 22
Sellion	0	0	0
Glabella	0	0	+ 14
Frontal +1	- 5	0	+ 25
Frontal +2	- 9	0	+ 34
Frontal +3	- 14	0	+ 44
Frontal +4	- 19	0	+ 52
Frontal +5	- 25	0	+ 60

Table 10. Three-Dimensional Data Points Of Female Subject F-12
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 17	- 49	- 16	- 18	+ 46	- 18
Medial Canthus	- 9	- 19	- 17	- 10	+ 16	- 18
Chelion	- 11	- 24	- 79	- 13	+ 24	- 78
Gonion	- 72	- 59	- 86	- 76	+ 55	- 84
Superior Nose Base	- 9	- 14	- 14	- 11	+ 11	- 14
Middle Nose Base	- 5	- 17	- 33	- 5	+ 16	- 33
Inferior Nose Base	- 4	- 16	- 50	- 5	+ 18	- 49
Superior Nose Bridge	- 3	- 9	- 9	- 3	+ 6	- 7
Middle Nose Bridge	+ 5	- 10	- 29	+ 3	+ 9	- 29
Inferior Nose Bridge	+ 14	- 13	- 48	+ 14	+ 13	- 47
Superior Orbital Rim	- 3	- 33	+ 7	- 4	+ 31	+ 5
Lateral Orbital Rim	- 29	- 60	- 12	- 30	+ 57	- 13
Inferior Orbital Rim	- 8	- 33	- 28	- 8	+ 31	- 26
Tragion	- 91	- 73	- 35	- 94	+ 68	- 38
Lateral Zygomatic Arch	- 61	- 70	- 24	- 54	+ 66	- 23

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 118
Promenton	+ 3	0	- 94
Supramentale	+ 4	0	- 77
Stomion	+ 6	+ 3	- 60
Subnasale	+ 27	+ 3	- 49
Pronasale	+ 14	+ 3	- 26
Midnasale	+ 1	+ 2	- 14
Sellion	0	0	0
Glabella	+ 1	0	+ 11
Frontal +1	+ 1	0	+ 23
Frontal +2	+ 1	0	+ 33
Frontal +3	+ 2	0	+ 44
Frontal +4	- 4	0	+ 53
Frontal +5	- 9	0	+ 61

Table 11. Three-Dimensional Data Points Of Female Subject F-11
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 18	- 45	- 11	- 17	+ 42	- 12
Medial Canthus	- 12	- 15	- 14	- 12	+ 11	- 12
Chelion	- 8	- 23	- 77	- 11	+ 26	- 78
Gonion	- 71	- 59	- 80	- 74	+ 60	- 82
Superior Nose Base	- 13	- 12	- 11	- 11	+ 8	- 8
Middle Nose Base	- 6	- 19	- 29	- 7	+ 18	- 26
Inferior Nose Base	- 2	- 17	- 45	- 3	+ 17	- 45
Superior Nose Bridge	- 4	- 8	- 5	- 4	+ 5	- 3
Middle Nose Bridge	+ 6	- 10	- 24	+ 5	+ 8	- 22
Inferior Nose Bridge	+ 15	- 12	- 41	+ 15	+ 12	- 40
Superior Orbital Rim	- 6	- 32	+ 9	- 5	+ 29	+ 12
Lateral Orbital Rim	- 34	- 57	- 8	- 30	+ 55	- 5
Inferior Orbital Rim	- 10	- 32	- 23	- 10	+ 29	- 21
Tragion	- 90	- 71	- 32	- 88	+ 71	- 30
Lateral Zygomatic Arch	- 62	- 69	- 27	- 55	+ 70	- 29

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 119
Promenton	+ 6	0	- 110
Supramentale	+ 4	0	- 92
Stomion	+ 7	- 1	- 78
Subnasale	+ 10	- 1	- 53
Pronasale	+ 30	0	- 38
Midnasale	+ 17	0	- 18
Sellion	0	0	0
Glabella	0	0	+ 14
Frontal +1	- 3	0	+ 25
Frontal +2	- 8	0	+ 34
Frontal +3	- 12	0	+ 43
Frontal +4	- 17	0	+ 52
Frontal +5	- 23	0	+ 60

Table 12. Three-Dimensional Data Points Of Male Subject M-28
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 22	- 47	- 9	- 20	+ 47	- 8
Medial Canthus	- 13	- 16	- 9	- 11	+ 18	- 7
Chelion	- 11	- 22	- 72	- 9	+ 27	- 68
Gonion	- 83	- 61	- 86	- 83	+ 62	- 88
Superior Nose Base	- 11	- 12	- 6	- 8	+ 12	- 3
Middle Nose Base	- 6	- 17	- 24	- 4	+ 21	- 23
Inferior Nose Base	- 4	- 17	- 46	- 2	+ 19	- 42
Superior Nose Bridge	- 4	- 7	- 2	- 2	+ 8	+ 2
Middle Nose Bridge	+ 5	- 9	- 22	+ 7	+ 10	- 19
Inferior Nose Bridge	+ 15	- 13	- 43	+ 17	+ 14	- 38
Superior Orbital Rim	- 4	- 34	+ 8	- 1	+ 33	+ 10
Lateral Orbital Rim	- 38	- 60	- 10	- 34	+ 59	- 7
Inferior Orbital Rim	- 11	- 34	- 21	- 11	+ 33	- 18
Tragion	- 100	- 74	- 25	- 99	+ 75	- 23
Lateral Zygomatic Arch	- 69	- 74	- 14	- 64	+ 75	- 13

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 110
Promenton	+ 9	0	- 100
Supramentale	+ 2	0	- 83
Stomion	+ 6	+ 2	- 71
Subnasale	+ 8	+ 2	- 53
Pronasale	+ 29	+ 2	- 42
Midnasale	+ 14	+ 2	- 20
Sellion	0	0	0
Glabella	+ 3	0	+ 19
Frontal +1	+ 1	0	+ 33
Frontal +2	- 1	0	+ 43
Frontal +3	- 5	0	+ 53
Frontal +4	- 11	0	+ 62
Frontal +5	- 17	0	+ 70

Table 13. Three-Dimensional Data Points Of Male Subject M-18
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 29	- 50	- 10	- 27	+ 49	- 14
Medial Canthus	- 17	- 16	- 11	- 16	+ 19	- 8
Chelion	- 12	- 27	- 75	- 13	+ 25	- 72
Gonion	- 69	- 60	- 91	- 72	+ 58	- 89
Superior Nose Base	- 15	- 13	- 9	- 15	+ 14	- 6
Middle Nose Base	- 12	- 20	- 28	- 12	+ 20	- 26
Inferior Nose Base	- 8	- 17	- 45	- 10	+ 17	- 43
Superior Nose Bridge	- 5	- 8	- 5	- 8	+ 10	- 3
Middle Nose Bridge	+ 2	- 10	- 24	- 1	+ 12	- 22
Inferior Nose Bridge	+ 13	- 13	- 43	+ 11	+ 13	- 40
Superior Orbital Rim	- 9	- 31	+ 10	- 9	+ 32	+ 12
Lateral Orbital Rim	- 44	- 57	- 5	- 42	+ 57	- 11
Inferior Orbital Rim	- 19	- 31	- 23	- 19	+ 32	- 21
Tragion	- 98	- 69	- 30	- 100	+ 70	- 34
Lateral Zygomatic Arch	- 75	- 68	- 27	- 76	+ 68	- 26

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 115
Promenton	+ 4	0	- 104
Supramentale	- 1	0	- 88
Stomion	+ 4	0	- 73
Subnasale	+ 9	+ 2	- 55
Pronasale	+ 26	+ 2	- 42
Midnasale	+ 11	+ 1	- 18
Sellion	0	0	0
Glabella	0	0	+ 16
Frontal +1	- 3	0	+ 29
Frontal +2	- 6	0	+ 40
Frontal +3	- 10	0	+ 51
Frontal +4	- 15	0	+ 58
Frontal +5	- 22	0	+ 65

Table 14. Three-Dimensional Data Points Of Male Subject M-24
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 22	- 48	- 12	- 20	+ 49	- 9
Medial Canthus	- 13	- 16	- 10	- 12	+ 16	- 7
Chelion	- 9	- 27	- 72	- 9	+ 28	- 70
Gonion	- 81	- 74	- 86	- 73	+ 76	- 81
Superior Nose Base	- 10	- 11	- 6	- 9	+ 9	- 2
Middle Nose Base	- 4	- 18	- 25	- 3	+ 18	- 23
Inferior Nose Base	- 6	- 21	- 38	- 4	+ 21	- 37
Superior Nose Bridge	- 4	- 9	- 5	- 1	+ 4	0
Middle Nose Bridge	+ 6	- 11	- 21	+ 8	+ 8	- 19
Inferior Nose Bridge	+ 14	- 16	- 35	+ 16	+ 12	- 32
Superior Orbital Rim	- 4	- 32	+ 9	- 5	+ 34	+ 14
Lateral Orbital Rim	- 42	- 62	- 13	- 41	+ 66	- 9
Inferior Orbital Rim	- 10	- 32	- 25	- 10	+ 34	- 19
Tragion	- 102	- 74	- 25	- 96	+ 78	- 20
Lateral Zygomatic Arch	- 68	- 75	- 22	- 64	+ 78	- 13

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 116
Promenton	+ 11	0	- 100
Supramentale	+ 4	0	- 87
Stomion	+ 6	0	- 70
Subnasale	+ 6	0	- 48
Pronasale	+ 26	- 1	- 34
Midnasale	+ 14	- 1	- 17
Sellion	0	0	0
Glabella	0	0	+ 16
Frontal +1	- 2	0	+ 27
Frontal +2	- 3	0	+ 37
Frontal +3	- 4	0	+ 48
Frontal +4	- 8	0	+ 57
Frontal +5	- 13	0	+ 64

Table 15. Three-Dimensional Data Points Of Male Subject M-09
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 22	- 45	- 16	- 23	+ 47	- 14
Medial Canthus	- 16	- 14	- 16	- 17	+ 16	- 15
Chelion	- 9	- 29	- 79	- 10	+ 28	- 78
Gonion	- 73	- 65	- 92	- 79	+ 63	- 90
Superior Nose Base	- 15	- 9	- 12	- 15	+ 10	- 11
Middle Nose Base	- 8	- 18	- 29	- 8	+ 19	- 28
Inferior Nose Base	- 6	- 20	- 48	- 6	+ 18	- 47
Superior Nose Bridge	- 4	- 7	- 7	- 5	+ 8	- 5
Middle Nose Bridge	+ 3	- 10	- 25	+ 2	+ 11	- 24
Inferior Nose Bridge	+ 15	- 15	- 40	+ 14	+ 14	- 40
Superior Orbital Rim	- 5	- 31	0	- 6	+ 33	+ 1
Lateral Orbital Rim	- 38	- 62	- 16	- 39	+ 62	- 16
Inferior Orbital Rim	- 16	- 31	- 28	- 16	+ 33	- 26
Tragion	- 98	- 75	- 33	- 99	+ 74	- 30
Lateral Zygomatic Arch	- 72	- 75	- 23	- 67	+ 73	- 21

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 118
Promenton	+ 5	0	- 105
Supramentale	0	0	- 95
Stomion	+ 8	- 2	- 79
Subnasale	+ 13	0	- 51
Pronasale	+ 29	0	- 38
Midnasale	+ 15	+ 1	- 18
Sellion	0	0	0
Glabella	+ 1	0	+ 9
Frontal +1	- 4	0	+ 22
Frontal +2	- 8	0	+ 33
Frontal +3	- 11	0	+ 43
Frontal +4	- 15	0	+ 52
Frontal +5	- 19	0	+ 62

Table 16. Three-Dimensional Data Points Of Male Subject M-01
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 34	- 56	- 7	- 39	+ 52	- 6
Medial Canthus	- 18	- 19	- 9	- 19	+ 19	- 5
Chelion	- 8	- 31	- 69	- 11	+ 30	- 65
Gonion	- 77	- 78	- 81	- 80	+ 69	- 85
Superior Nose Base	- 16	- 15	- 7	- 16	+ 14	- 3
Middle Nose Base	- 10	- 22	- 23	- 13	+ 22	- 19
Inferior Nose Base	- 9	- 23	- 38	- 10	+ 22	- 32
Superior Nose Bridge	- 6	- 10	- 5	- 6	+ 9	0
Middle Nose Bridge	- 1	- 13	- 18	0	+ 13	- 16
Inferior Nose Bridge	+ 8	- 14	- 30	+ 9	+ 13	- 28
Superior Orbital Rim	- 7	- 36	+ 7	- 9	+ 35	+ 10
Lateral Orbital Rim	- 49	- 69	- 2	- 47	+ 66	- 3
Inferior Orbital Rim	- 19	- 36	- 18	- 19	+ 35	- 13
Tragion	- 111	- 81	- 22	- 116	+ 76	- 23
Lateral Zygomatic Arch	- 68	- 80	- 17	- 85	+ 81	- 16

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 118
Promenton	+ 7	0	- 104
Supramentale	+ 4	0	- 86
Stomion	+ 7	0	- 66
Subnasale	+ 7	0	- 46
Pronasale	+ 24	0	- 29
Midnasale	+ 8	0	- 16
Sellion	0	0	0
Glabella	+ 1	0	+ 16
Frontal +1	- 3	0	+ 31
Frontal +2	- 7	0	+ 40
Frontal +3	- 10	0	+ 50
Frontal +4	- 12	0	+ 59
Frontal +5	- 18	0	+ 70

Table 17. Three-Dimensional Data Points Of Male Subject M-10
(millimeters)

Bilateral Landmarks	Right Lateral X Axis	Right Lateral Y Axis	Right Lateral Z Axis	Left Lateral X Axis	Left Lateral Y Axis	Left Lateral Z Axis
Lateral Canthus	- 24	- 45	- 10	- 24	+ 45	- 8
Medial Canthus	- 16	- 15	- 10	- 16	+ 14	- 9
Chelion	- 6	- 23	- 75	- 6	+ 26	- 73
Gonion	- 68	- 57	- 86	- 65	+ 59	- 83
Superior Nose Base	- 14	- 11	- 7	- 14	+ 10	- 6
Middle Nose Base	- 9	- 18	- 27	- 7	+ 17	- 26
Inferior Nose Base	- 7	- 19	- 45	- 5	+ 19	- 43
Superior Nose Bridge	- 5	- 8	- 3	- 6	+ 7	- 2
Middle Nose Bridge	+ 2	- 11	- 24	+ 3	+ 8	- 22
Inferior Nose Bridge	+ 13	- 15	- 43	+ 14	+ 12	- 40
Superior Orbital Rim	- 6	- 28	+ 6	- 6	+ 30	+ 8
Lateral Orbital Rim	- 36	- 55	- 9	- 37	+ 56	- 8
Inferior Orbital Rim	- 16	- 28	- 22	- 16	+ 30	- 19
Tragion	- 96	- 71	- 28	- 98	+ 72	- 25
Lateral Zygomatic Arch	- 59	- 67	- 24	- 63	+ 67	- 22

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 119
Promenton	+ 6	0	- 107
Supramentale	+ 3	0	- 91
Stomion	+ 5	- 1	- 75
Subnasale	+ 10	- 2	- 52
Pronasale	+ 27	- 3	- 42
Midnasale	+ 13	0	- 21
Sellion	0	0	0
Glabella	0	0	+ 16
Frontal +1	- 5	0	+ 28
Frontal +2	- 8	0	+ 38
Frontal +3	- 12	0	+ 47
Frontal +4	- 17	0	+ 56
Frontal +5	- 23	0	+ 62

Table 18. Three-Dimensional Data Points Of Male Subject M-30
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 17	- 48	- 10	- 18	+ 47	- 11
Medial Canthus	- 11	- 17	- 10	- 12	+ 16	- 9
Chelion	- 14	- 30	- 73	- 13	+ 27	- 73
Gonion	- 77	- 71	- 87	- 76	+ 67	- 90
Superior Nose Base	- 11	- 11	- 4	- 9	+ 10	- 4
Middle Nose Base	- 6	- 16	- 23	- 6	+ 16	- 24
Inferior Nose Base	- 9	- 20	- 40	- 7	+ 15	- 40
Superior Nose Bridge	- 4	- 6	- 1	- 3	+ 5	0
Middle Nose Bridge	+ 2	- 9	- 22	+ 4	+ 8	- 21
Inferior Nose Bridge	+ 13	- 16	- 38	+ 15	+ 11	- 37
Superior Orbital Rim	+ 2	- 31	+ 15	+ 1	+ 31	+ 15
Lateral Orbital Rim	- 33	- 66	- 5	- 32	+ 63	- 7
Inferior Orbital Rim	- 10	- 31	- 18	- 10	+ 31	- 19
Tragion	- 98	- 77	- 27	- 99	+ 76	- 29
Lateral Zygomatic Arch	- 64	- 80	- 16	- 61	+ 78	- 13

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 119
Promenton	+ 5	0	- 105
Supramentale	0	0	- 89
Stomion	+ 2	- 2	- 70
Subnasale	+ 7	- 1	- 50
Pronasale	+ 28	- 1	- 38
Midnasale	+ 14	- 1	- 19
Sellion	0	0	0
Glabella	+ 4	0	+ 19
Frontal +1	+ 1	0	+ 29
Frontal +2	- 2	0	+ 38
Frontal +3	- 5	0	+ 47
Frontal +4	- 9	0	+ 57
Frontal +5	- 15	0	+ 65

Table 19. Three-Dimensional Data Points Of Male Subject M-06
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 24	- 51	- 13	- 27	+ 51	- 11
Medial Canthus	- 15	- 18	- 14	- 17	+ 17	- 12
Chelion	- 5	- 28	- 77	- 4	+ 28	- 75
Gonion	- 73	- 69	- 98	- 76	+ 64	- 102
Superior Nose Base	- 13	- 14	- 12	- 14	+ 11	- 9
Middle Nose Base	- 5	- 19	- 28	- 6	+ 19	- 25
Inferior Nose Base	- 1	- 20	- 46	0	+ 18	- 45
Superior Nose Bridge	- 4	- 9	- 7	- 5	+ 9	- 4
Middle Nose Bridge	+ 3	- 12	- 22	+ 4	+ 9	- 19
Inferior Nose Bridge	+ 20	- 10	- 20	+ 21	+ 8	- 39
Superior Orbital Rim	- 6	- 35	+ 1	- 8	+ 31	+ 4
Lateral Orbital Rim	- 38	- 67	- 11	- 43	+ 66	- 8
Inferior Orbital Rim	- 12	- 35	- 25	- 12	+ 31	- 22
Tragion	- 98	- 82	- 31	- 102	+ 74	- 30
Lateral Zygomatic Arch	- 58	- 79	- 31	- 57	+ 75	- 26

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 119
Promenton	+ 4	0	- 110
Supramentale	+ 1	0	- 90
Stomion	+ 11	+ 3	- 75
Subnasale	+ 19	+ 2	- 52
Pronasale	+ 32	0	- 37
Midnasale	+ 14	0	- 17
Sellion	0	0	0
Glabella	+ 2	0	+ 14
Frontal +1	- 5	0	+ 26
Frontal +2	- 8	0	+ 36
Frontal +3	- 10	0	+ 45
Frontal +4	- 15	0	+ 55
Frontal +5	- 20	0	+ 65

Table 20. Three-Dimensional Data Points Of Male Subject M-29
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 24	- 52	- 9	- 22	+ 47	- 12
Medial Canthus	- 14	- 21	- 9	- 13	+ 17	- 12
Chelion	0	- 25	- 74	- 1	+ 22	- 77
Gonion	- 71	- 63	- 87	- 69	+ 60	- 93
Superior Nose Base	- 12	- 14	- 7	- 10	+ 12	- 7
Middle Nose Base	- 5	- 21	- 22	- 4	+ 15	- 25
Inferior Nose Base	- 2	- 20	- 42	- 1	+ 16	- 43
Superior Nose Bridge	- 5	- 11	- 5	- 4	+ 7	- 4
Middle Nose Bridge	+ 4	- 11	- 20	+ 6	+ 6	- 21
Inferior Nose Bridge	+ 16	- 14	- 38	+ 15	+ 9	- 36
Superior Orbital Rim	- 5	- 35	+ 12	- 3	+ 32	+ 13
Lateral Orbital Rim	- 41	- 64	- 7	- 37	+ 62	- 10
Inferior Orbital Rim	- 11	- 35	- 18	- 11	+ 32	- 19
Tragion	- 97	- 76	- 36	- 96	+ 74	- 38
Lateral Zygomatic Arch	- 67	- 73	- 22	- 67	+ 70	- 26

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 120
Promenton	+ 7	0	- 108
Supramentale	0	0	- 93
Stomion	+ 10	- 2	- 73
Subnasale	+ 10	- 1	- 51
Pronasale	+ 26	- 1	- 36
Midnasale	+ 12	- 2	- 16
Sellion	0	0	0
Glabella	+ 2	0	+ 18
Frontal +1	- 1	0	+ 26
Frontal +2	- 5	0	+ 36
Frontal +3	- 8	0	+ 47
Frontal +4	- 12	0	+ 56
Frontal +5	- 18	0	+ 66

Table 21. Three-Dimensional Data Points Of Male Subject M-19
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 23	- 50	- 13	- 26	+ 48	- 13
Medial Canthus	- 13	- 18	- 12	- 13	+ 15	- 11
Chelion	- 1	- 26	- 76	- 1	+ 23	- 75
Gonion	- 66	- 70	- 88	- 70	+ 59	- 90
Superior Nose Base	- 11	- 14	- 11	- 11	+ 10	- 8
Middle Nose Base	- 6	- 18	- 27	- 7	+ 18	- 25
Inferior Nose Base	- 4	- 18	- 45	- 2	+ 17	- 44
Superior Nose Bridge	- 5	- 9	- 7	- 4	+ 6	- 3
Middle Nose Bridge	+ 4	- 10	- 12	+ 2	+ 10	- 21
Inferior Nose Bridge	+ 16	- 14	- 39	+ 13	+ 13	- 39
Superior Orbital Rim	- 6	- 33	+ 5	- 7	+ 30	+ 7
Lateral Orbital Rim	- 39	- 65	- 10	- 39	+ 58	- 10
Inferior Orbital Rim	- 12	- 33	- 23	- 12	+ 30	- 21
Tragion	- 94	- 76	- 33	- 98	+ 76	- 34
Lateral Zygomatic Arch	- 60	- 75	- 27	- 62	+ 69	- 18

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 120
Promenton	+ 8	0	- 106
Supramentale	+ 8	0	- 94
Stomion	+ 10	0	- 73
Subnasale	+ 12	0	- 50
Pronasale	+ 25	+ 1	- 38
Midnasale	+ 10	+ 1	- 19
Sellion	0	0	0
Glabella	+ 1	0	+ 17
Frontal +1	- 4	0	+ 29
Frontal +2	- 8	0	+ 38
Frontal +3	- 12	0	+ 47
Frontal +4	- 16	0	+ 56
Frontal +5	- 20	0	+ 65

Table 22. Three-Dimensional Data Points Of Male Subject M-23
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 22	- 49	- 15	- 20	+ 46	- 13
Medial Canthus	- 14	- 18	- 13	- 14	+ 16	- 10
Chelion	- 11	- 29	- 82	- 10	+ 26	- 80
Gonion	- 83	- 67	- 98	- 84	+ 61	- 97
Superior Nose Base	- 12	- 14	- 9	- 11	+ 12	- 7
Middle Nose Base	- 4	- 21	- 30	- 3	+ 19	- 28
Inferior Nose Base	- 2	- 23	- 47	- 3	+ 20	- 47
Superior Nose Bridge	- 5	- 10	- 6	- 4	+ 8	- 5
Middle Nose Bridge	+ 6	- 14	- 26	+ 8	+ 13	- 24
Inferior Nose Bridge	+ 19	- 18	- 44	+ 19	+ 15	- 39
Superior Orbital Rim	- 6	- 34	+ 6	- 3	+ 30	+ 8
Lateral Orbital Rim	- 40	- 65	- 16	- 37	+ 61	- 12
Inferior Orbital Rim	- 12	- 34	- 22	- 12	+ 30	- 20
Tragion	- 95	- 73	- 35	- 97	+ 73	- 34
Lateral Zygomatic Arch	- 67	- 75	- 34	- 65	+ 70	- 30

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 124
Promenton	+ 7	0	- 110
Supramentale	- 4	0	- 98
Stomion	+ 7	- 2	- 83
Subnasale	+ 13	- 3	- 58
Pronasale	+ 32	- 2	- 42
Midnasale	+ 14	- 4	- 22
Sellion	0	0	0
Glabella	+ 2	0	+ 20
Frontal +1	- 3	0	+ 33
Frontal +2	- 9	0	+ 41
Frontal +3	- 14	0	+ 50
Frontal +4	- 18	0	+ 58
Frontal +5	- 24	0	+ 66

Table 23. Three-Dimensional Data Points Of Male Subject M-27
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 21	- 43	- 15	- 22	+ 49	- 17
Medial Canthus	- 14	- 15	- 14	- 17	+ 21	- 13
Chelion	- 16	- 26	- 80	- 15	+ 28	- 78
Gonion	- 80	- 59	- 91	- 78	+ 58	- 97
Superior Nose Base	- 12	- 11	- 8	- 16	+ 16	- 7
Middle Nose Base	- 9	- 18	- 29	- 9	+ 24	- 28
Inferior Nose Base	- 10	- 18	- 51	- 10	+ 20	- 49
Superior Nose Bridge	- 5	- 7	- 6	- 7	+ 13	- 3
Middle Nose Bridge	+ 1	- 9	- 27	+ 3	+ 13	- 24
Inferior Nose Bridge	+ 12	- 12	- 50	+ 10	+ 16	- 46
Superior Orbital Rim	- 3	- 31	+ 8	- 4	+ 36	+ 8
Lateral Orbital Rim	- 39	- 59	- 14	- 42	+ 62	- 16
Inferior Orbital Rim	- 16	- 31	- 27	- 16	+ 36	- 26
Tragion	- 97	- 74	- 33	- 104	+ 76	- 40
Lateral Zygomatic Arch	- 65	- 69	- 29	- 65	+ 72	- 37

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 126
Promenton	+ 3	0	- 114
Supramentale	- 1	0	- 100
Stomion	- 1	+ 1	- 80
Subnasale	+ 1	+ 2	- 61
Pronasale	+ 22	+ 2	- 50
Midnasale	+ 12	+ 2	- 26
Sellion	0	0	0
Glabella	+ 1	0	+ 15
Frontal +1	- 2	0	+ 30
Frontal +2	- 5	0	+ 40
Frontal +3	- 10	0	+ 49
Frontal +4	- 15	0	+ 58
Frontal +5	- 22	0	+ 66

Table 24. Three-Dimensional Data Points Of Male Subject M-14
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 28	- 50	- 18	- 25	+ 50	- 12
Medial Canthus	- 15	- 17	- 17	- 15	+ 18	- 13
Chelion	- 8	- 28	- 85	- 8	+ 31	- 80
Gonion	- 72	- 66	- 104	- 77	+ 66	- 104
Superior Nose Base	- 15	- 13	- 12	- 15	+ 15	- 7
Middle Nose Base	- 6	- 21	- 31	- 7	+ 24	- 29
Inferior Nose Base	+ 2	- 18	- 51	+ 1	+ 21	- 47
Superior Nose Bridge	- 5	- 10	- 6	- 8	+ 12	- 3
Middle Nose Bridge	+ 7	- 10	- 27	+ 4	+ 16	- 25
Inferior Nose Bridge	+ 22	- 12	- 45	+ 21	+ 18	- 43
Superior Orbital Rim	- 9	- 33	+ 2	- 10	+ 36	+ 7
Lateral Orbital Rim	- 43	- 62	- 16	- 41	+ 63	- 11
Inferior Orbital Rim	- 15	- 33	- 29	- 15	+ 36	- 25
Tragion	- 107	- 74	- 43	- 107	+ 77	- 39
Lateral Zygomatic Arch	- 65	- 74	- 32	- 61	+ 76	- 31

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 126
Promenton	+ 8	0	- 112
Supramentale	+ 3	0	- 98
Stomion	+ 12	+ 2	- 82
Subnasale	+ 18	+ 3	- 62
Pronasale	+ 36	+ 5	- 44
Midnasale	+ 19	+ 3	- 21
Sellion	0	0	0
Glabella	- 1	0	+ 14
Frontal +1	- 8	0	+ 26
Frontal +2	- 12	0	+ 35
Frontal +3	- 17	0	+ 43
Frontal +4	- 21	0	+ 50
Frontal +5	- 26	0	+ 58

Table 25. Three-Dimensional Data Points Of Male Subject M-07
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 24	- 52	- 13	- 24	+ 50	- 14
Medial Canthus	- 14	- 18	- 11	- 13	+ 17	- 8
Chelion	- 3	- 30	- 81	- 4	+ 26	- 79
Gonion	- 72	- 62	- 97	- 74	+ 59	- 95
Superior Nose Base	- 12	- 13	- 10	- 12	+ 13	- 5
Middle Nose Base	- 5	- 19	- 30	- 4	+ 17	- 26
Inferior Nose Base	- 2	- 19	- 48	+ 4	+ 18	- 46
Superior Nose Bridge	- 4	- 8	- 5	- 5	+ 8	- 1
Middle Nose Bridge	+ 6	- 9	- 27	+ 4	+ 12	- 23
Inferior Nose Bridge	+ 18	- 12	- 41	+ 15	+ 17	- 39
Superior Orbital Rim	- 6	- 34	+ 8	- 9	+ 33	+ 10
Lateral Orbital Rim	- 39	- 63	- 13	- 37	+ 58	- 14
Inferior Orbital Rim	- 13	- 34	- 26	- 13	+ 33	- 23
Tragion	- 97	- 73	- 33	- 98	+ 66	- 35
Lateral Zygomatic Arch	- 70	- 73	- 21	- 70	+ 68	- 23

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 126
Promenton	+ 6	0	- 115
Supramentale	+ 7	0	- 103
Stomion	+ 10	- 1	- 79
Subnasale	+ 14	+ 4	- 55
Pronasale	+ 31	+ 2	- 41
Midnasale	+ 15	+ 4	- 23
Sellion	0	0	0
Glabella	- 1	0	+ 23
Frontal +1	- 7	0	+ 36
Frontal +2	- 14	0	+ 45
Frontal +3	- 20	0	+ 54
Frontal +4	- 26	0	+ 61
Frontal +5	- 33	0	+ 69

Table 26. Three-Dimensional Data Points Of Male Subject M-26
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 21	- 50	- 10	- 19	+ 47	- 12
Medial Canthus	- 13	- 16	- 11	- 12	+ 12	- 10
Chelion	- 11	- 29	- 80	- 10	+ 24	- 80
Gonion	- 83	- 79	- 89	- 85	+ 71	- 92
Superior Nose Base	- 11	- 12	- 6	- 11	+ 12	- 6
Middle Nose Base	- 7	- 19	- 28	- 7	+ 16	- 27
Inferior Nose Base	- 7	- 24	- 46	- 6	+ 18	- 48
Superior Nose Bridge	- 5	- 9	- 4	- 3	+ 3	- 3
Middle Nose Bridge	+ 3	- 11	- 26	+ 3	+ 7	- 24
Inferior Nose Bridge	+ 17	- 17	- 46	+ 17	+ 12	- 45
Superior Orbital Rim	- 1	- 33	+ 11	0	+ 30	+ 11
Lateral Orbital Rim	- 37	- 66	- 7	- 34	+ 65	- 10
Inferior Orbital Rim	- 10	- 33	- 26	- 10	+ 30	- 23
Tragion	- 98	- 81	- 30	- 100	+ 77	- 34
Lateral Zygomatic Arch	- 64	- 78	- 17	- 67	+ 76	- 15

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 126
Promenton	+ 4	0	- 116
Supramentale	0	0	- 101
Stomion	+ 7	- 2	- 82
Subnasale	+ 9	- 3	- 58
Pronasale	+ 28	- 3	- 45
Midnasale	+ 12	- 2	- 23
Sellion	0	0	0
Glabella	+ 3	0	+ 18
Frontal +1	- 1	0	+ 31
Frontal +2	- 5	0	+ 40
Frontal +3	- 10	0	+ 50
Frontal +4	- 15	0	+ 58
Frontal +5	- 21	0	+ 67

Table 27. Three-Dimensional Data Points Of Male Subject M-21
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 21	- 52	- 13	- 20	+ 49	- 14
Medial Canthus	- 10	- 20	- 13	- 10	+ 15	- 11
Chelion	- 14	- 33	- 80	- 18	+ 27	- 79
Gonion	- 81	- 69	- 88	- 73	+ 64	- 94
Superior Nose Base	- 10	- 13	- 11	- 10	+ 10	- 8
Middle Nose Base	- 4	- 22	- 26	- 5	+ 20	- 27
Inferior Nose Base	- 2	- 25	- 47	- 5	+ 20	- 46
Superior Nose Bridge	- 2	- 10	- 7	- 2	+ 5	- 5
Middle Nose Bridge	+ 7	- 12	- 24	+ 4	+ 11	- 24
Inferior Nose Bridge	+ 19	- 16	- 44	+ 17	+ 13	- 42
Superior Orbital Rim	0	- 36	+ 6	+ 3	+ 30	+ 5
Lateral Orbital Rim	- 36	- 66	- 6	- 34	+ 63	- 9
Inferior Orbital Rim	- 9	- 36	- 24	- 9	+ 30	- 23
Tragion	- 105	- 78	- 35	- 105	+ 77	- 33
Lateral Zygomatic Arch	- 68	- 80	- 23	- 66	+ 78	- 24

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 127
Promenton	+ 8	0	- 112
Supramentale	+ 2	0	- 98
Stomion	+ 6	- 2	- 82
Subnasale	+ 11	- 2	- 54
Pronasale	+ 27	+ 1	- 43
Midnasale	+ 12	- 1	- 23
Sellion	0	0	0
Glabella	+ 6	0	+ 11
Frontal +1	+ 4	0	+ 23
Frontal +2	+ 2	0	+ 33
Frontal +3	- 1	0	+ 42
Frontal +4	- 5	0	+ 52
Frontal +5	- 10	0	+ 60

Table 28. Three-Dimensional Data Points Of Male Subject M-25
(millimeters)

Bilateral Landmarks	Right Lateral			Left Lateral		
	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 23	- 55	- 17	- 23	+ 47	- 20
Medial Canthus	- 15	- 19	- 15	- 15	+ 16	- 13
Chelion	- 15	- 32	- 84	- 16	+ 26	- 81
Gonion	- 78	- 77	- 88	- 79	+ 61	- 96
Superior Nose Base	- 12	- 13	- 10	- 12	+ 10	- 8
Middle Nose Base	- 8	- 21	- 31	- 8	+ 17	- 33
Inferior Nose Base	- 9	- 20	- 47	- 9	+ 16	- 47
Superior Nose Bridge	- 4	- 9	- 6	- 5	+ 6	- 4
Middle Nose Bridge	+ 3	- 12	- 26	+ 5	+ 6	- 26
Inferior Nose Bridge	+ 13	- 16	- 44	+ 13	+ 11	- 43
Superior Orbital Rim	0	- 35	+ 6	- 1	+ 29	+ 4
Lateral Orbital Rim	- 41	- 69	- 13	- 42	+ 63	- 15
Inferior Orbital Rim	- 13	- 35	- 28	- 13	+ 29	- 30
Tragion	- 97	- 81	- 28	- 98	+ 75	- 31
Lateral Zygomatic Arch	- 71	- 79	- 17	- 71	+ 76	- 20

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 131
Promenton	+ 8	0	- 118
Supramentale	- 1	0	- 104
Stomion	+ 5	- 1	- 81
Subnasale	+ 8	- 2	- 56
Pronasale	+ 27	- 3	- 46
Midnasale	+ 11	- 2	- 23
Sellion	0	0	0
Glabella	+ 3	0	+ 12
Frontal +1	+ 2	0	+ 24
Frontal +2	+ 3	0	+ 34
Frontal +3	0	0	+ 44
Frontal +4	- 5	0	+ 54
Frontal +5	- 9	0	+ 61

Table 29. Three-Dimensional Data Points Of Male Subject M-22
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 19	- 48	- 15	- 19	+ 46	- 12
Medial Canthus	- 16	- 17	- 16	- 15	+ 16	- 13
Chelion	- 7	- 31	- 85	- 6	+ 28	- 82
Gonion	- 79	- 68	- 103	- 86	+ 65	- 97
Superior Nose Base	- 15	- 15	- 14	- 12	+ 13	- 11
Middle Nose Base	- 8	- 24	- 33	- 8	+ 21	- 29
Inferior Nose Base	- 7	- 25	- 48	- 7	+ 23	- 45
Superior Nose Bridge	- 5	- 12	- 9	- 6	+ 10	- 5
Middle Nose Bridge	+ 1	- 16	- 30	+ 4	+ 12	- 25
Inferior Nose Bridge	+ 13	- 19	- 48	+ 14	+ 14	- 43
Superior Orbital Rim	- 3	- 33	+ 4	- 2	+ 31	+ 9
Lateral Orbital Rim	- 37	- 65	- 15	- 35	+ 62	- 12
Inferior Orbital Rim	- 12	- 33	- 26	- 12	+ 31	- 25
Tragion	- 92	- 81	- 34	- 94	+ 79	- 31
Lateral Zygomatic Arch	- 65	- 78	- 34	- 65	+ 75	- 34

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 135
Promenton	+ 8	0	- 121
Supramentale	+ 2	0	- 105
Stomion	+ 7	- 3	- 82
Subnasale	+ 8	- 3	- 58
Pronasale	+ 26	- 4	- 47
Midnasale	+ 14	- 3	- 24
Sellion	0	0	0
Glabella	0	0	+ 14
Frontal +1	- 4	0	+ 27
Frontal +2	- 9	0	+ 35
Frontal +3	- 13	0	+ 44
Frontal +4	- 18	0	+ 53
Frontal +5	- 24	0	+ 61

Table 30. Three-Dimensional Data Points Of Male Subject M-16
(millimeters)

	Right Lateral			Left Lateral		
Bilateral Landmarks	X Axis	Y Axis	Z Axis	X Axis	Y Axis	Z Axis
Lateral Canthus	- 30	- 51	- 18	- 27	+ 47	- 21
Medial Canthus	- 14	- 19	- 18	- 17	+ 16	- 16
Chelion	- 12	- 29	- 89	- 12	+ 27	- 87
Gonion	- 71	- 63	- 108	- 75	+ 60	- 111
Superior Nose Base	- 12	- 16	- 16	- 13	+ 13	- 13
Middle Nose Base	- 7	- 24	- 33	- 8	+ 21	- 33
Inferior Nose Base	- 5	- 21	- 52	- 6	+ 20	- 51
Superior Nose Bridge	- 2	- 12	- 7	- 5	+ 10	- 6
Middle Nose Bridge	+ 7	- 14	- 27	+ 4	+ 14	- 28
Inferior Nose Bridge	+ 19	- 15	- 47	+ 13	+ 16	- 48
Superior Orbital Rim	- 8	- 34	+ 2	- 9	+ 33	+ 3
Lateral Orbital Rim	- 46	- 63	- 13	- 44	+ 59	- 15
Inferior Orbital Rim	- 15	- 34	- 30	- 15	+ 33	- 29
Tragion	- 105	- 75	- 40	- 105	+ 73	- 40
Lateral Zygomatic Arch	- 75	- 74	- 35	- 80	+ 71	- 23

Midsagittal Landmarks	X Axis	Y Axis	Z Axis
Menton	0	0	- 137
Promenton	+ 5	0	- 121
Supramentale	- 2	0	- 105
Stomion	+ 4	+ 2	- 87
Subnasale	+ 13	+ 1	- 61
Pronasale	+ 32	+ 3	- 46
Midnasale	+ 18	+ 1	- 23
Sellion	0	0	0
Glabella	+ 3	0	+ 15
Frontal +1	- 6	0	+ 26
Frontal +2	- 11	0	+ 36
Frontal +3	- 16	0	+ 44
Frontal +4	- 21	0	+ 53
Frontal +5	- 28	0	+ 60

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