

Use of MicroScribe Digitizer

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Use of MicroScribe Digitizer

1 INTRODUCTION

This document provides instructions for the use of the MicroScribe Digitizer and associated software programs for transferring digitized data. The MicroScribe Digitizer is a tool for collecting 3-dimensional coordinate data from osteometric landmarks of the cranium and mandible for estimation of sex and population affinity. This can replace or complement 2-dimensional data collection procedures.

2 SCOPE

This document applies to Anthropology Examiners and Physical Scientists in the Trace Evidence Unit (TEU) who utilize the MicroScribe Digitizer.

3 EQUIPMENT

- MicroScribe G2LX digitizer, or equivalent
- 3Skull software
- Advantage Data Architect (“ARC”) software
- Fordisc 3.1 (or more recent version) software
- Cranium stand (e.g., tri-column clay and/or acrylic stand, or equivalent)
- Mandible stand (e.g., tri-column clay and/or acrylic stand, or equivalent)
- Clay
- Mirror
- Pencil
- Rubber band

4 PROCEDURE

4.1 Preparing the Digitizer

- A. Check the connections between the digitizer and computer and the digitizer and the input accessory (hand switch or foot pedal) to ensure they are secure. Check the stylus tip to ensure it is secured.
- B. Home the digitizer by placing the stylus in the stylus holder and pressing the white Home button in the back of the base.
- C. Assess the digitizer system to ensure it is in “Normal operation” status using the LED indicator on the base (see Table 1).

Table 1: LED status indicator (adapted from Revware Systems 2009)

| LED Status | Device Status | Details |
|------------------|------------------|--|
| OFF | OFF | The MicroScribe system is not powered. |
| RED (Flashing) | Powered | The MicroScribe system is powered but is not homed and is not communicating with the computer. |
| RED | Not homed | The MicroScribe system is communicating with the computer but has not been homed. |
| GREEN (Flashing) | Connection lost | The MicroScribe system has been homed but is not communicating with the computer. |
| GREEN | Normal operation | The MicroScribe system has been homed and is communicating with the computer. |

4.2 Preparing the Cranium and Mandible for Digitizing

- A. Mark instrumentally determined landmarks (see Appendix A) using a pencil. Other landmarks may also be marked at the discretion of the examiner.
- B. If alveolon will be captured, place a thin rubber band around the alveolus.
- C. Place and stabilize the cranium on the stand such that all landmarks are accessible and the digitizer arm can reach all of the landmarks. Typically, two of the three columns are positioned behind the left and right mastoid processes, and the third is positioned under the left or right molars. Clay can be used to stabilize the cranium if using an acrylic stand. The orientation of the cranium is not important.
- D. Place and stabilize the mandible on the stand such that all landmarks are accessible and the digitizer arm can reach all of the landmarks. Clay can be used to stabilize the mandible on the stand. The orientation of the mandible is not important.
- E. Once digitizing has begun, the positions of the cranium and mandible cannot be changed.

4.3 Preparing the 3Skull Program

- A. Open the 3Skull (Ousley 2014) program so that the control screen is visible.
- B. The "CATKEY" field entry is not important; "Anthro" or other generic discipline indicator can be entered. Enter the Laboratory Number into the "Individual" field.
- C. Enter the initials of the examiner into the "Recorder" field.
- D. Select the radio button for the "MicroScribe" digitizer.
- E. Select the Coordinate Table ("coord") into which the data will be entered, which should be "3DCoords.adt" (which stores the raw x, y, and z coordinates). If it does not exist, it can be created by selecting "New."
- F. Create a new Craniometric Table ("cran") file (which converts landmarks to interlandmark distances) by clicking the "New" button. The file name should be [Lab Number]cran[Initials].adt. It is recommended that a new "cran" file is created for each case.
- G. Select the most current landmark table which provides the landmark ordering for 3Skull. "Lndmrk13F.ADT" is the most current file. The file version should be periodically checked and updated (along with Appendix A) as needed. If it does not

exist, it can be downloaded from <http://math.mercyhurst.edu/~sousley/Software/> and saved to the “refdbs” folder within the digital 3Skull folder; then close and reopen 3Skull.

- H. Select the “Start” button to begin digitizing. Once digitizing begins, it must be completed in a single session. If the 3Skull data collection screen is closed, the case cannot be reopened.

4.4 Digitizing the Cranium and Mandible

- A. The digitizer should be tested prior to each digitizing session. To test, after clicking the “Start” button, click the “Test” button. Collect two data points from a ruler or caliper by placing the stylus tip at the first point and pressing the capture button on the input accessory. The yellow “Ready” label should then be displayed. Next, move the stylus tip to a second point and press the capture button. The calculated distance will be displayed in mm and should correspond to the distance between the two points on the ruler or caliper. Testing can be repeated. To end the test mode, click the “Test” button again.
- B. If the cranium has any anomalies that may skew collected data (e.g., trauma, pathology, taphonomy, missing bone, etc.), the “Cranial reshaping” field should be changed from “N” (indicating no anomalies) to “Y” (indicating anomalies). The “Comments” field can be used to clarify the anomalies.
- C. To begin digitizing, click the “X” coordinate field for the first measurement. The 3Skull program will then navigate the examiner through the osteometric points (see Appendix A). To collect each point, place the stylus onto the landmark and press the capture button. 3Skull will then automatically advance to the next landmark. Landmarks are as defined by Langley et al. (2016) which are derived from Howells (1973) and Martin & Knussmann (1988) unless otherwise noted. Fleishman & Crowder (2018) provide some useful tips and guidance for collecting certain landmarks.
- D. Landmarks can be skipped (for example if they are not present) or recaptured (for example if the point was collected in error) using the manual controls to advance or go back. The “Erase XYZ” button removes the previous data point. If the field is not highlighted in green, the “X” coordinate will need to be clicked to recapture the measurement.
- E. Estimated measurements (for example due to missing or damaged bone) are not generally advised but may be used at the discretion of the examiner. Measurements that are estimated can be noted in 3Skull using the “Comments” field.
- F. After osteometric landmarks for the cranium are captured, the program will advance to mandibular landmarks. The same procedures are followed as for the cranium.
- G. Interlandmark distances and angles from the mandible can also be acquired using calipers and/or mandibulometer and manually entered into 3Skull in the “Data Review” field.
- H. Arcs can be captured at any time during the data collection process, but it is recommended that they be captured following collection of osteometric landmarks. Arcs are collected by positioning the stylus on the starting point of the arc (see Appendix A), pressing and releasing the capture button, carefully dragging the stylus

across the surface of the bone to the terminal point of the arc, and then pressing and releasing the capture button again. Be sure the field turns back to yellow (indicating the digitizer is no longer collecting points) before removing the stylus from the terminal point.

- I. Once landmarks and arcs have been captured, save the data to the previously configured database files in the 3Skull folder by clicking “Add to DBs.”
- J. 3Skull will then perform a measurement check for outliers and possible errors. If there are no errors, the “Data Review” screen will be populated, and the program can be closed by clicking “OK.” If errors are noted, manual navigation can be used to retake measurements. If 3Skull continues to indicate an error but the data point is believed to be correct, the “Skip Meas. Check” box can be selected.
- K. Open the ARC software and select the appropriate “cran” file through the path C:\Program Files\3Skull\data. Check to ensure that the data were converted to measurements. Export the measurements to a new (*.adt) table.

4.5 Importing Data into FORDISC

- A. Open FORDISC (Jantz & Ousley 2005) and open the exported table. The measurements from the table should populate the FORDISC input screen.
- B. Analyze data using standard procedures for FORDISC (Ousley & Jantz 2012, Jantz & Ousley 2017).
- C. The FORDISC file can be saved to the desktop or USB drive.

5 LIMITATIONS

The conclusions that can be reached from anthropological examinations are dependent on the condition and completeness of the submitted material. Limitations specific to particular examination may be found in the relevant procedures.

6 SAFETY

- While working with physical evidence, laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).
- Universal precautions will be followed.
- Exposure to physical, biological, and chemical hazards may be associated with the examination techniques performed. Safety procedures related to specific materials, instruments or equipment will be followed. Refer to the [FBI Laboratory Safety Manual](#) for guidance.

7 REFERENCES

Jantz, R.L., Ousley, S.D. Introduction to FORDISC 3 and Human Variation Statistics. In: Langley NR and Tersigni-Tarrant MTA, Forensic Anthropology: A Comprehensive Introduction, Second Edition. Boca Raton: CRC Press, p. 255-270, 2017.

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8 REVISION HISTORY

| Revision | Issued | Changes |
|----------|------------|--|
| 00 | 08/02/2021 | Original document issued. |
| 01 | 01/28/2022 | Formatting and language changes to conform to new template. |
| 02 | 03/15/2024 | Deleted Anthro-300 from References. Section 1 language revised to reflect language in ANSI-ASB Standard 132 (Population Affinity Estimation). |

APPENDIX A: LIST OF OSTEO-METRIC LANDMARKS, ARCS, AND SUBTENSES CAPTURED USING THE MICROSCRIBE DIGITIZER

The most recent landmark list for 3Skull is “Lndmrk13F” (as of November 2018) and contains a total of 111 landmarks. Shaded landmarks are instrumentally determined and must be marked prior to digitizing.

Cranium Landmarks

| # | Landmark | Measurement | Brief Description |
|----|---------------------------------|------------------|---|
| 1 | Prosthion-Howells | BPL, NPH | Midline point at the most anterior point on the alveolar process of the maxillae. |
| 2 | Prosthion-Martin | UFHT | Midline point at the inferior tip of the alveolar process of the maxillae |
| 3 | Subspinale | SSR, SSS | The deepest point seen in the profile below the anterior nasal spine. |
| 4 | Alare L | NLB | The most lateral point on the margin of the nasal aperture taken on the anterior surface. |
| 5 | Most inferior nasal border L | NLH | Actual floor of the nasal cavity, taken inside the nasal aperture if there is guttering or the stylus will fit into the nasal aperture. If there is a nasal sill, place stylus on the anterior surface of the maxilla to approximate the location of nasal floor. |
| 6 | Most inferior nasal border R | NLH | |
| 7 | Alare R | NLB | The most lateral point on the margin of the nasal aperture taken on the anterior surface. |
| 8 | Zygoorbitale L | MOW, IML, XML | The intersection of the orbital margin and the zygomaticomaxillary suture. |
| 9 | Nasale inferius L | | The most inferior point where the nasal touches the maxilla. |
| 10 | Nasale inferius R | | |
| 11 | Zygoorbitale R | MOW, IML, XML | The intersection of the orbital margin and the zygomaticomaxillary suture. |
| 12 | Lower orbital border L/R | OBH (inf. point) | The height between the upper and lower borders of the left orbit, perpendicular to the long axis of the orbit and bisecting it. Internal measurement. |
| 13 | Upper orbital border L/R | OBH (sup. point) | |
| 14 | Cheek height superior point L/R | WMH | The minimum distance, in any direction, from the lower border of the orbit to the lower margin of the maxilla, medial to the masseter attachment. |

| # | Landmark | Measurement | Brief Description |
|----|---------------------------------|-------------|--|
| 15 | Cheek height inferior point L/R | WMH | |
| 16 | Ectoconchion L | OBB, EKB | The intersection of the most anterior surface of the lateral border of the orbit and a line bisecting the orbit along its long axis. |
| 17 | Dacryon L | OBB, DKB | Anterior border of the junction of the lacrimal and frontal. Apex of lacrimal fossa on the frontal bone. |
| 18 | Nasale superius L | | The most superior point where the nasal touches the maxilla. |
| 19 | Nasomaxillary suture pinch L | WNB | The minimum transverse breadth across the two nasal bones. |
| 20 | Nasomaxillary suture pinch R | WNB | |
| 21 | Nasale superius R | | The most superior point where the nasal touches the maxilla. |
| 22 | Dacryon R | DKB | Anterior border of the junction of the lacrimal and frontal. Apex of lacrimal fossa on the frontal bone. |
| 23 | Ectoconchion R | EKB | The intersection of the most anterior surface of the lateral border of the orbit and a line bisecting the orbit along its long axis. |
| 24 | Zygion R | ZYB | Maximum lateral extent of the zygomatic arch. |
| 25 | Zygotemporale inferior R | IML, XML | Point at the inferior zygotemporal suture on the zygomatic process. |
| 26 | Zygotemporale superior R | IML, XML | Point at the superior zygotemporal suture on the zygomatic process. |
| 27 | Zygomaxillare R | ZMB | Intersection of zygomaxillary suture and limit of the attachment of the masseter muscle, on the facial (most anteriorly projecting) surface of the zygomaxillary suture. |
| 28 | Zygomaxillare L | ZMB, IML | |
| 29 | Zygotemporale superior L | | Point at the superior zygotemporal suture on the zygomatic process. |
| 30 | Zygotemporale inferior L | IML, XML | Point at the inferior zygotemporal suture on the zygomatic process. |
| 31 | Zygion L | ZYB | Maximum lateral extent of the zygomatic arch. |
| 32 | Jugale L | JUB | Deepest curvature of the zygomatic angle, taken laterally, not on the margin. |

| # | Landmark | Measurement | Brief Description |
|----|----------------------------|-------------|---|
| 33 | Marginal process lateral L | | Point at the lateral-most aspect of the marginal process of the zygomatic. |
| 34 | Frontomalaretemporale L | UFBR | Point where the frontozygomatic suture crosses the temporal line. |
| 35 | Frontomalare anterior L | FMB, NAS | Point where the frontozygomatic suture intersects with the orbit. |
| 36 | Frontotemporale L | WFB | Point generally anterior and medial along the temporal line (minimum frontal breadth). |
| 37 | Sphenofrontale L | | Point where the sphenoid, frontal, and zygomatic sutures intersect. |
| 38 | Sphenion L | | The anterior tip of the parietal (the intersection of the parietal and sphenoid at the coronal suture). |
| 39 | Krotaphion L | | The superior-posterior tip of the greater wing of the sphenoid. |
| 40 | Maximum frontal point L | XFB | Instrumentally-determined, maximum frontal breadth; on the coronal suture. |
| 41 | Stephanion L | STB, STS | Point where the coronal suture crosses the temporal line (left and right). |
| 42 | Stephanion R | STB, STS | |
| 43 | Maximum frontal point R | XFB | Instrumentally-determined, maximum frontal breadth; on the coronal suture. |
| 44 | Krotaphion R | | The superior-posterior tip of the greater wing of the sphenoid. |
| 45 | Sphenion R | | The anterior tip of the parietal. |
| 46 | Sphenofrontale R | | Point where the sphenoid, frontal, and zygomatic sutures intersect. |
| 47 | Frontotemporale R | WFB | Point generally anterior and medial along the temporal line on the frontal bone that, when paired with Frontotemporale L, measures the minimum frontal breadth. |
| 48 | Frontomalare anterior R | FMB, NAS | Point where the frontozygomatic suture intersects with the orbit. Point is taken anterior. |
| 49 | Frontomalaretemporale R | UFBR | Point where the frontozygomatic suture crosses the temporal line. This is taken on the frontozygomatic suture at the most lateral point – wherever that point may be. |
| 50 | Marginal process lateral R | | Point at the lateral-most aspect of the marginal process of the zygomatic. |

| # | Landmark | Measurement | Brief Description |
|----|--------------------|-----------------|---|
| 51 | Jugale R | JUB | Deepest curvature of the zygomatic angle, taken laterally, not on the margin. |
| 52 | Nasion | NOL, NLH, NAS | Point of intersection of the nasofrontal suture and the mid-sagittal plane, on the frontal bone. |
| 53 | Glabella | GOL | The most forwardly projection point in the mid-sagittal plane at the lower margin of the frontal bone. |
| 54 | Supraglabellare | GLS | The point at which the convex profile of the frontal bone changes to join the prominence of the glabellar region. |
| 55 | Bregma | FRC, PAC, BBH | Point where the coronal and sagittal sutures intersect. |
| 56 | Lambda | PAC, OCC | Point where the sagittal and lambdoidal sutures meet. |
| 57 | Asterion L | ASB | The point where the lambdoidal, parietomastoid, and occipitomastoid sutures meet. |
| 58 | Eurion L | XCB | Instrumentally-determined, ectocranial point of greatest cranial breadth. |
| 59 | Radiometer point L | radii NAR, BRR. | Taken inside the EAM, "floating." Refer to section 9.7 for instructions. |
| 60 | Porion L | MDH | Point at the most superior aspect of the EAM. |
| 61 | Mastoideale L | MDH | Point at the most inferior tip of the mastoid. |
| 62 | Radiculare L | AUB | Deepest point on the zygomatic root (bi-auricular breadth). |
| 63 | Radiculare R | AUB | |
| 64 | Radiometer point R | radii NAR, BRR. | Taken inside the EAM, "floating." Refer to section 9.7 for instructions |
| 65 | Porion R | MDH | Point at the most superior aspect of the EAM. |
| 66 | Mastoideale R | MDH | Point at the most inferior tip of the mastoid. |
| 67 | Eurion R | XCB | Instrumentally-determined, ectocranial point of greatest cranial breadth. |
| 68 | Asterion R | ASB | The point where the lambdoidal, parietomastoid, and occipitomastoid sutures meet. |
| 69 | Opisthion | FOL | Midline point at the posterior margin of the foramen magnum. |
| 70 | Basion | BBH, BNL | Midline point at the anterior margin of the foramen magnum. |

| # | Landmark | Measurement | Brief Description |
|----|---------------------|-------------|---|
| 71 | FOB Point R | FOB | Foramen magnum breadth. |
| 72 | FOB Point L | FOB | |
| 73 | Hormion | | The most posterior midline point on the vomer. |
| 74 | Alveolon | MAL | Use rubber band. Point on the interpalatal suture where the line drawn between the posterior ends of the alveolar ridges crosses the midline. |
| 75 | Staurion | | The point at the intersection of the median and transverse palatine sutures. |
| 76 | Ectomolare L | MAB | Widest part of the alveolar maxilla, around M2. |
| 77 | M1 Anterior Point L | AVR | Anterior/mesial margin of the left first molar, on the alveolus. |
| 78 | Ectomolare R | MAB | Widest part of the alveolar maxilla, around M2. |

Mandible Landmarks

| # | Landmark | Measurement | Brief Definition |
|----|------------------------------|-------------|--|
| 79 | Pogonion | XRL, MAN | Most anterior midline point on the chin of the mandible. |
| 80 | Gnathion | GNI | The most inferior midline point on the mandible. |
| 81 | Infradentale | GNI | The midline point on the alveolar bone between the two central mandibular incisors. |
| 82 | HMF inferior point L/R | HMF | Mandibular body height at the mental foramen. |
| 83 | HMF superior point L/R | HMF | |
| 84 | TMF buccal point L/R | TMF | Mandibular body breadth at the mental foramen. |
| 85 | TMF lingual point L/R | TMF | |
| 86 | Gonion L | GOG | The most lateral external point at the junction of the horizontal and ascending rami. |
| 87 | Mandibular angle base L | MAN | Point on the posterior base of the mandible as if you were measuring ramus height with a mandibulometer. |
| 88 | Coronion L | | Point at the tip of the coronoid process of the mandible. |
| 89 | Inf mandibular notch point L | | Lowest point between condyle and coronion. |
| 90 | Condylionlaterale L | BCB | Lateral-most projection of the mandibular condyle. |
| 91 | Sup condyle L | | Highest point on the mandibular condyle. |
| 92 | Sup condyle post L | CDL, MAN | Perpendicular to the highest point on the mandibular condyle as if it were sitting in a mandibulometer. |
| 93 | Condylionmediale L | | Medial-most projection of the mandibular condyle. |
| 94 | Condylionmediale R | | Medial-most projection of the mandibular condyle. |
| 95 | Sup condyle R | | Highest point on the mandibular condyle. |
| 96 | Sup condyle post R | | Perpendicular to the highest point on the mandibular condyle as if it were sitting in a mandibulometer. |
| 97 | Condylionlaterale R | BCB | Lateral-most projection of the mandibular condyle. |

| # | Landmark | Measurement | Brief Definition |
|-----|------------------------------|-------------|--|
| 98 | Inf mandibular notch point R | | Lowest point between condyle and coronion. |
| 99 | Coronion R | | Point at the tip of the coronoid process of the mandible. |
| 100 | Mandibular angle base R | MAN | Point on the posterior base of the mandible as if you were measuring ramus height with a mandibulometer. |
| 101 | Gonion R | GOG | The most lateral external point at the junction of the horizontal and ascending rami. |
| 102 | WRB posterior point (R or L) | WRB | Minimum ramus breadth. |
| 103 | WRB anterior point (R or L) | WRB | |

Calculated Points (No Need to Digitize)

| # | Landmark | Measurement | Brief Definition |
|-----|-------------------------------------|-------------|--|
| 104 | Nasal bone elevation | SIS, SIA | Calculated from nasal arc. |
| 105 | Deepest point on nasal bone profile | NDS, NDA | Calculated from nasal arc. |
| 106 | Max malar projection point L/R | MLS | Calculated from malar arc. |
| 107 | Metopion | FRF, FRS | Instrumentally-determined, point where the frontal's elevation above the chord from nasion to bregma is greatest. |
| 108 | Parietal subtense point | PAF, PAS | The maximum subtense, at the highest point on the convexity of the parietal bones, within the bregma-lambda chord, in midline. |
| 109 | Vertex radius point | VRR | Instrumentally-determined, the highest point at midline when the skull is in Frankfurt Horizontal. |
| 110 | Opisthocranium | GOL | Instrumentally-determined, the furthest point from glabella in midline. |
| 111 | Occipital subtense point | OCF, OCS | The maximum subtense, at the highest point on the convexity along the lambda-opisthion chord, in midline. |

Arcs

| # | Arc | Measurement | Quick Description |
|---|---------------|-------------|---|
| 1 | Frontal Arc | FRA | From bregma to nasion. (P to A) |
| 2 | Parietal Arc | PAA | From lambda to bregma. (P to A) |
| 3 | Occipital Arc | OCA | From opisthion to lambda. (A to P) |
| 4 | Malar Arc | MAA | From zygoorbitale to zygotemporale <i>inferior</i> . (M to L) |
| 5 | Nasal Arc | NAA | From nasion to rhinion. (S to I) |