

FAS Facial Photographic Analysis Software

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www.fasdpn.org
Version 2.1.0
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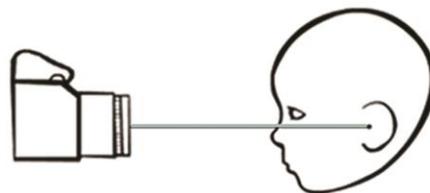


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Watch for Updates on the FAS DPN Website

fasdpn.org

ACKNOWLEDGMENTS

The development of this software was supported in part by:

Royalty Research Fund
University of Washington
Seattle, Washington

Washington Research Foundation
Seattle, Washington

John B. Chavez FAS Fund

James M. Kinzel, programmer, V 1.0.0
Mantis Technology Group, Inc. V.2.0.0.
ProKarma, Inc V.2.1.0

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About FAS Facial Photographic Analysis Software

FAS Facial Photographic Analysis Software [Version 2.1.0]

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PART I. INTRODUCTION

What is Fetal alcohol syndrome (FAS)?

Fetal alcohol syndrome (FAS) is a permanent birth defect syndrome caused by maternal consumption of alcohol during pregnancy. The syndrome has been broadly characterized by pre- and/or postnatal growth deficiency, a characteristic set of minor facial anomalies, central nervous system (CNS) abnormalities (Jones and Smith, 1973; Clarren and Smith, 1978; Smith, 1979; Rosett, 1980; Sokol and Clarren, 1989; Stratton *et al.*, 1996). Although these previous publications do provide guidance, they are not sufficiently specific to assure diagnostic accuracy and precision. In 1997, a new more rigorous and comprehensive, case-defined method for diagnosing the full spectrum of outcomes in individuals with prenatal alcohol exposure was created called the FASD 4-Digit Diagnostic Code (Astley & Clarren, 1997, 1999, 2000; Astley et al., 1999, Astley, 2004a). The 4-Digit Code is a validated set of guidelines intended for use by an interdisciplinary team in a FASD diagnostic clinic (Astley, 2011, 2013; Astley et. al. 2009).

The FASD 4-Digit Diagnostic Code

The four digits of the diagnostic code reflect the magnitude of expression of four key diagnostic features of FAS/D in the following order: (1) growth deficiency, (2) the FAS facial phenotype, (3) CNS abnormalities, and (4) gestational alcohol exposure (Fig. 1). The 4-Digit Diagnostic Code is generated by first recording key clinical data on the standardized FASD Diagnostic Evaluation Form and following specific case-definitions to generate each digit.

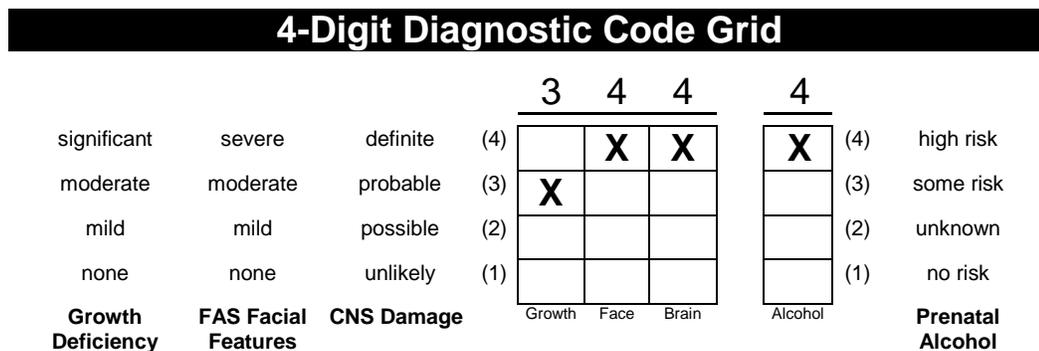
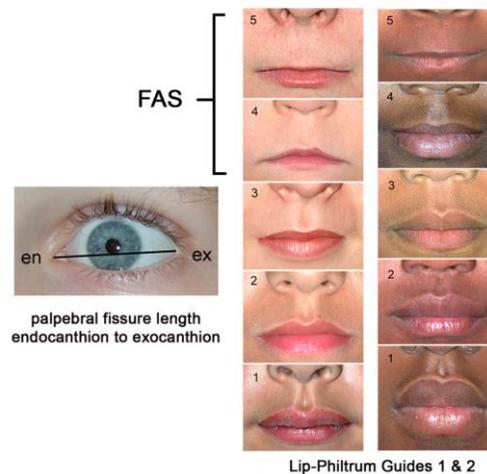


Fig. 1. The magnitude of expression of each feature is ranked independently on a 4-point Likert scale with 1 reflecting complete absence of the FAS feature and 4 reflecting a strong "classic" presence of the FAS feature. Each Likert rank is specifically case-defined. The 4-Digit Diagnostic Code can be used to diagnose individuals of all ages. The 4-Digit Diagnostic Code has been used effectively for diagnosis (Astley & Clarren, 2000), screening (Astley et. al., 2002) and surveillance (Astley, 2003) efforts in the Washington State FAS Diagnostic & Prevention Network of clinics since 1997 (Astley et al., 2014). The 2004 diagnostic guide entitled “*Diagnostic Guide for Fetal Alcohol Spectrum Disorders: The 4-Digit Diagnostic Code*” the *Lip-Philtrum Guides*, and the *FAS Facial Photographic Analysis Software* can be ordered from the website fasdpn.org.

Facial Features of FAS

The most specific feature of FAS is the facial phenotype. The FAS facial phenotype is characterized by the presence of all three of the following minor anomalies at any single point in time:

1. **Palpebral fissure lengths** (PFL) two or more standard deviations below the mean.
2. A **smooth philtrum** defined as a Rank 4 or Rank 5 on the 5-point likert scale depicted on the FAS DPN Lip-Philtrum Guides (Astley & Clarren, 1999, 2000).
3. A **thin upper lip** (thin vermilion border) defined as a Rank 4 or Rank 5 on the 5-point Likert Scale depicted on the FAS DPN Lip-Philtrum Guides (Astley & Clarren, 1999, 2000).



This case-definition for the FAS facial phenotype was derived empirically by Astley and Clarren (1995, 1996), matches the original definition by Smith (1979), and is confirmed to be highly sensitive and specific to FAS and prenatal alcohol exposure (Astley & Clarren 1996, 2001; Astley et al., 2002; 2009; 2013).

Other facial anomalies may be present. The presence of other anomalies should be recorded, but should not be used in lieu of any of the three diagnostic features (small palpebral fissures, smooth philtrum, and thin upper lip) of the FAS facial phenotype.

FAS Facial Analysis Software

This software was developed for use by health care and medical research professionals. Computerized image analysis has been used effectively to measure and rank the magnitude of expression of the FAS facial phenotype on thousands of individuals evaluated in the FAS DPN clinics (Astley & Clarren, 2001; Astley et al., 2002, Astley, 2010, 2013). This software was developed to provide healthcare professionals with a user-friendly, inexpensive, objective method for analyzing facial photographs obtained in a clinical or research setting. Please read the License Agreement for further details.

PART II. GETTING STARTED

Professional qualifications for use of this software

This software is intended for use by healthcare and research professionals.

Computer System

This software is a Microsoft WINDOWS application. Please go to fasdpn.org for computer system specifications.

To Install the Facial Software, Version 2.0.0 (2012) or Version 2.1.0 (2016)

Please go to the fasdpn.org website for the most current installation instructions.

To Upgrade from Version 1.0.0 (2003) to Version 2.0.0 (2012) or Version 2.1.0 (2016)

Please go to the fasdpn.org website for the upgrade instructions.

Version 2.0.0 provides the following additional features:

1. Two additional PFL normal growth charts are included: Canadian and Scandinavian. These new charts are considered more accurate (Astley, 2011a) growth charts for Caucasian PFLs than the Hall (1989) PFL growth charts. See more details posted on the fasdpn.org website.
2. Version 1 required all photo analysis data be stored in a single database file that could only be named **data.fas**. This file was permanently positioned in the FAS software's data directory in the following path (**C:\Program Files\FAS\Data\data.fas**). Version 2 allows the User to assign any name to the database file (e.g., **data2012.fas**) and place it anywhere on their hard drive or server. By default the Version 2 database file is named **data2012.fas** and is placed in the following path (**C:\FAS\Data\data2012.fas**). The User can create multiple database files. They can browse to locate and select which database file they want their photo analysis data to be stored in.

Version 2.1.0 includes the new Lip-Philtrum Guides with frontal and ¾ view images.

A User can upgrade to Version 2.0.0 or 2.1.0 without losing the photo analysis data they have accumulated to date using Version 1.0.

Help

A copy of the License Agreement and a copy of this Instruction Manual can be found by clicking on the Help button in the top menu bar when the software is open. Please use your IT support personnel.

Fundamentals Regarding Version 2

1. The software installation program loads the software in a FAS folder off the C: drive **C:\FAS**
2. The data you generate from analyzing photographs is stored in a Microsoft Access database that comes with the software. This is why the software requires you to have Microsoft Office/Access installed.
3. When you install the software, the Access database is assigned the default name **data2012.fas** and is placed in the following path: **C:\FAS\Data\data2012.fas**
4. After you install the software, you can assign any name to this Access database as long as it ends in **.fas**. You can also store the Access database anywhere on your computer. And you can create more than one Access database to store your photo analysis data.
5. Your photo images are NOT stored in the software's Access database. Your photo images are stored wherever you decide to store them on your computer. When you open a photo into the software for analysis, the software stores the current location (or path) of the photo on your hard drive in the Access database. This allows the software to locate the photo if you choose to evaluate it again. If you move the photo on your hard drive after you have analyzed the photo, the software will not know where to find the photo. The Access database only stores the original location (path) of the photo. Keep this in mind as you organize your photos for analysis.
6. The facial software contains formulas to calculate palpebral fissure length (PFL) and inner canthal distance (ICD) z-scores. These formulas are generated from published growth charts. These formulas are stored in the same Access database as your photo analysis data. If you are installing Version 2 of the software, these formulas come with the default Access database (**data2012.fas**). If you have Access databases created with version 1.0, some of these formulas (Canadian and Scandinavian formulas) will be missing. This will not pose a problem. There are directions below for how to import these new formulas into your version 1.0 databases.
7. You can load this software on as many computers as you like.
8. We cannot provide software support. We recommend you involve your IT support personnel when installing this software.

To Open the Software

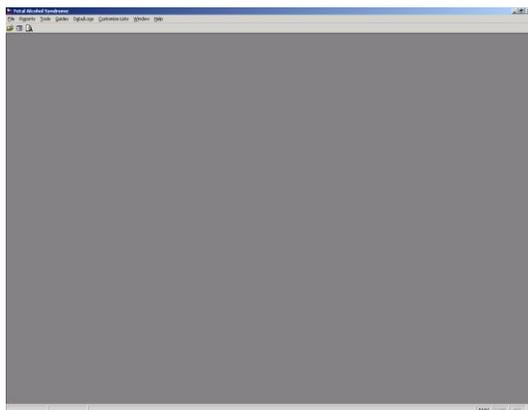


Fig. 2. This blank screen will appear when you open the software.

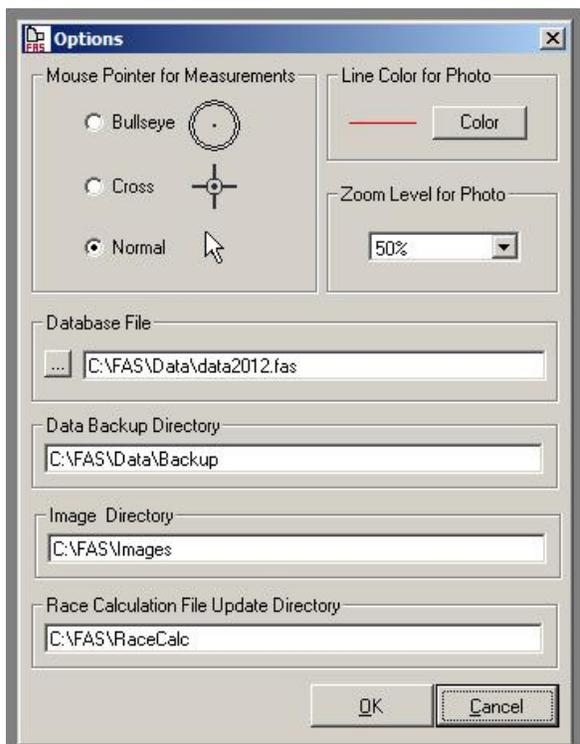


Fig. 3. The Options window allows you to select the directory where you want your backup files to be stored. It also allows you to designate which folder to go to first to look for new images to analyze.

1. Left mouse click on the Windows start button in the lower left corner of your monitor. Left mouse click on “Launch FAS.exe”.
2. The software will open to the following blank screen (Fig. 2).
3. If you loaded Version 2.0 or 2.1 for the first time, the software will open, pointing to the default **data2012.fas database**, where your photo analysis data will be stored. This blank database comes with one “practice case: John Doe” permanently stored in it (for training purposes). When you start analyzing photos, your data will also be stored in this database.
4. If you want to store your data in a different database (perhaps a previous database with photo analysis data already in it that you created using Version 1.0), do the following:

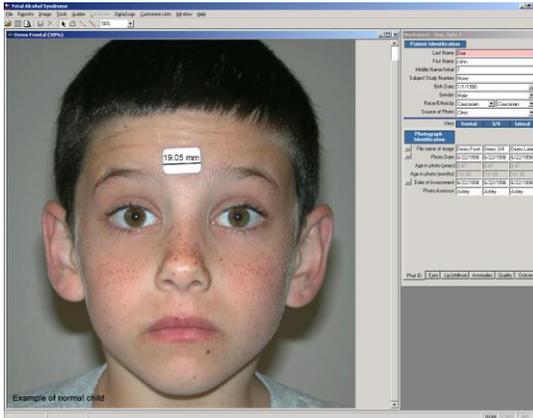
a) Left mouse click Tools in the menu at the top (Fig. 2). Left mouse click on Options from the drop-down menu to open the Options screen (Fig. 3).

b) Left mouse click on the browser button under “Database File” (Fig. 3). Navigate to the **.fas** database you want to store your photo analysis data in.

c) Click OK. Restart the software.

d) **IMPORTANT:** If you selected a **.fas** database created from Version 1.0, the new Canadian and Scandinavian PFL growth charts will be missing. See “**Importing New Racial Calculations for PFL Z-scores**” below.

To Open the “John Doe” Demonstration Case



John Doe Demonstration/Practice Case
John Doe has normal facial features.

Follow the instructions below to open the existing demonstration case called “John Doe”.

This fictitious demonstration case provides an example of a completed analysis. It also serves as a Practice Case. Instructions for using the Practice Case are presented later in this Instruction Manual.

1. To open Select File/Open/Existing Subject File from the top menu bar.
2. Double-click on the file named John Doe.
3. Click on the OK button.

PART III. TAKING THE FACIAL PHOTOGRAPHS

How to take the 3 standardized facial photographs



Fig 4. Standardized Photo Set Guide. Example of a normally developed child.

Internal Measure of Scale: An internal measure of scale (adhesive paper sticker) is placed on the patient's forehead between their eyebrows (Fig. 4). It should not be placed high on the forehead or off center to the right or left. A small, adhesive paper sticker 1/2 inch to 3/4 inch in size serves well and can be purchased from an office supply store. Do not use "homemade" stickers. Use store-bought stickers that are machine cut for accuracy. Make sure the sticker is firmly attached (not curled up along the edges). Print the size of the sticker on the sticker.

Frontal, 3/4 and Lateral Pictures: A frontal, a 3/4 view, and a lateral photograph of the patient's face are obtained using a digital camera (Fig. 4). The 3/4 view is taken to facilitate ranking philtrum smoothness by purposely driving a flash of light across the philtrum to see if a shadow is cast. Stand approximately 3 feet from the patient and zoom in with the camera lens so that the patient's head fills the entire frame. This provides the highest resolution image. Be careful not to distort the photo by holding the camera too close to the patient's face (see our website fasdnpn.org for more details).

Facial Expression: The facial expression should be relaxed with no smile, lips gently closed, eyes wide open and no eyeglasses. A smile will make the lip appear thinner and the philtrum appear smoother than they truly are (Fig. 5).

Fig. 5. This is the same child with and without a smile. When the child smiles, her lip appears thinner and her philtrum appears smoother than it truly is. Rankings based on the top photo would be inaccurate.



Rotation: The lens of the camera should be placed in-line with the patient's *Frankfort Horizontal Plane* as illustrated in Fig. 6A. To determine if the camera is in the patient's Frankfort Horizontal Plane when viewing the face through the camera, an imaginary line drawn between the upper border of the left tragus and right tragus should fall across the left and right lower bony orbital rims (Fig. 6B). There should also be no left-to-right rotation of the image; both ears should be equally visible in the frontal photo.

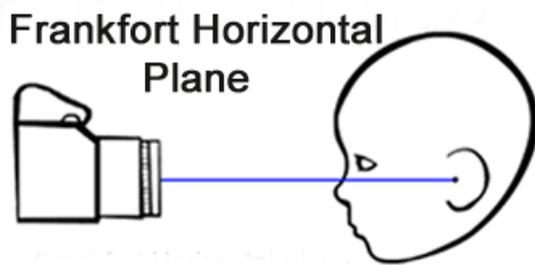


Fig. 6A. The center of the camera lens is placed in the patient's Frankfort Horizontal Plane (a line drawn from the external auditory canal through the lower border of the bony orbital rim (orbitale)).

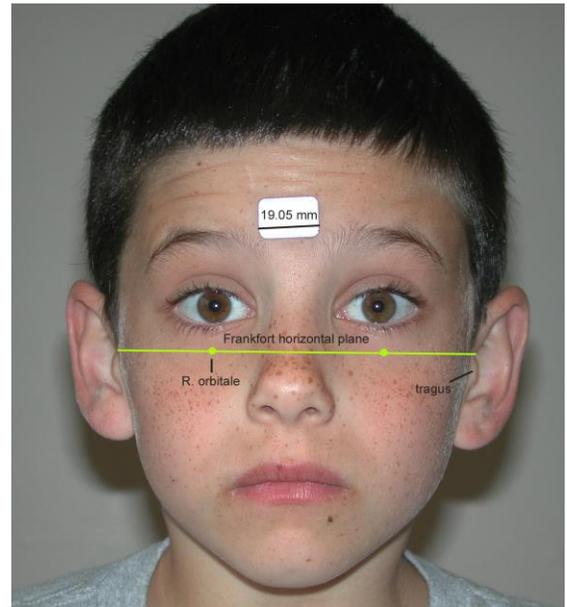


Fig. 6B. When viewing the patient through the camera, the camera is in the patient's Frankfort Horizontal Plane if a line drawn between the left and right auditory canals (or the upper border of the right tragus and left tragus) falls along the right and left orbitale landmarks.

Impact of Rotation on Measurement of Features *Upward-Rotation (head tipped back)* will make the upper lip appear thicker than it truly is. All other features will be unaffected. *Downward-Rotation:* will make the upper lip appear thinner than it truly is. All other features will be unaffected. *Right or Left Rotation* will cause the circularity measure for lip thinness to be smaller (thicker) than it truly is because the length of the lip will be foreshortened. The mean PFL and inner canthal distance will remain accurate even with marked left or right rotation as long as the endocanthion and exocanthion landmarks are clearly discernable. The reason mean PFL and inner canthal distance are largely unaffected by right-left rotation is because the internal measure of scale is also rotating by an equal degree.

Properly aligned facial photographs are obtained in the FAS DPN clinics with a hand-held camera and seated patient. Stereotaxic equipment and tripods are not necessary. Take multiple photos if necessary. Sometimes one photo will provide a good measure of the eyes while a second photo will provide a good measure of the lips.

Additional Training / Instructional Resources: More detailed pictorial and animated instruction for how to take standardized facial photographs can be obtained from the [FAS DPN website](#) and the research publications by Astley (2011a, 2015) posted on the website.

Camera / Image Resolution Specifications

Digital Camera

The recommended minimum specifications for a digital camera are:

- 3 Mega Pixel resolution or greater
- Flash
- Zoom feature that allows you to fill the camera frame with the facial image.

Image Resolution

In general, an ideal facial image has at least 1000 data points (or pixels) across the width of the face when the image is viewed at its original magnification (or 100% zoom).

Image Formats

This software imports the following image formats

- jpeg (.jpg)
- tiff (.tif)
- bitmap (.bmp)

PART IV. USING THE MEASUREMENT TOOLS, PICTORIAL GUIDES AND SCORING TABLES

Tools and Guides to Measure Facial Features

- Several tools and pictorial guides are provided to help you measure the facial features.
- Select the tools and guides from the TOOLS and GUIDES drop-down menus.
- An image must be open and 'active' before a TOOL can be selected. To activate a photo, click your mouse anywhere on the open photo and the top border of the photo will turn blue.
- Each TOOL and GUIDE is described below.

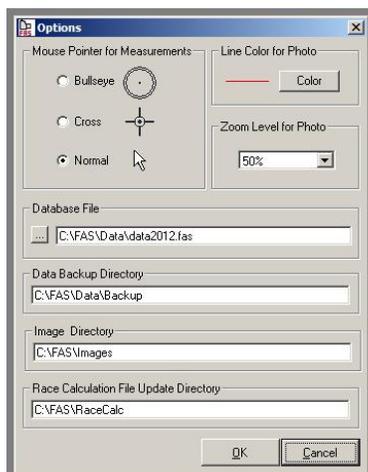
TOOLS include:

- Pointer for pointing to objects.
- Circularity Tool for outlining upper lip thinness.
- Single Distance Tool for measuring the size of the internal measure of scale (paper sticker).
- 3-Distances Tool for measuring the left and right palpebral fissure lengths and the inner canthal distance.
- Tool Options to select style of pointer, line color, etc.

GUIDES include:

- Picture Guides
 1. 2 Lip-Philtrum Guides (Caucasian and Black).
 2. FAS Face/Other Anomalies Guide provides a pictorial example of the FAS facial features and other commonly seen minor facial anomalies.
 3. Rotation Guides (Up/Down, Left, Right) document different degrees of rotation in frontal images.
 4. Landmark/Rotation Guide identifying key facial landmarks and proper image rotation.
 5. Standardized Photo Set Guide providing an example of the frontal, ¾ and lateral photos.
- Table Guide for deriving the ABC-Score for the face.
- Circularity Practice Guide for practicing outline upper lips to compute circularity.

Tool Options Guide



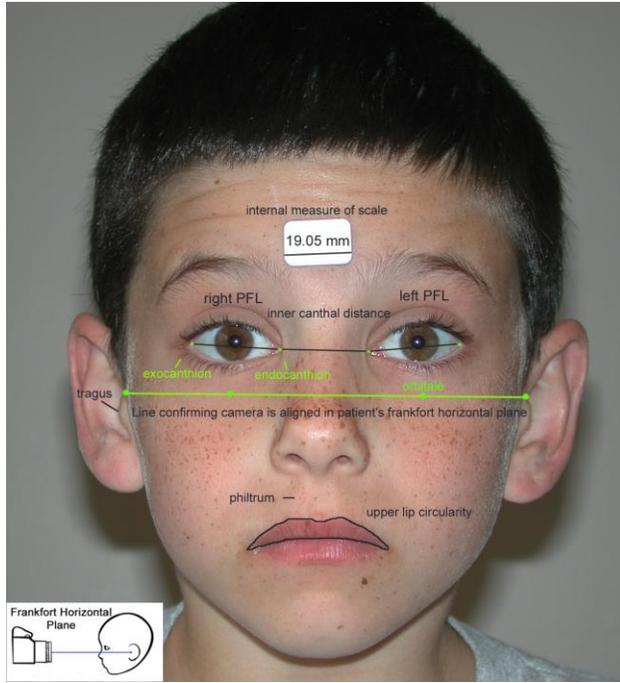
To Use: Select from the Guides drop-down menu from the top menu bar.

The User can select the following options:

- Mouse Pointer style for the Circularity, Single Distance and 3-Distance Tools.
- Line color.
- Default zoom level for the Photo.
- Database File that is currently active.
- Directory where backups will be stored.
- Directory where software will first go to when asked to open a new photo.
- Directory for PFL race formulas.

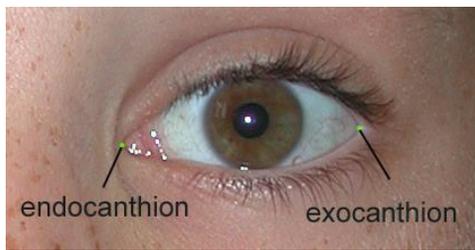
Identifying Key Facial Features

The Landmark/Rotation Guide



To view: Select from the Guides drop-down menu on the top menu bar.

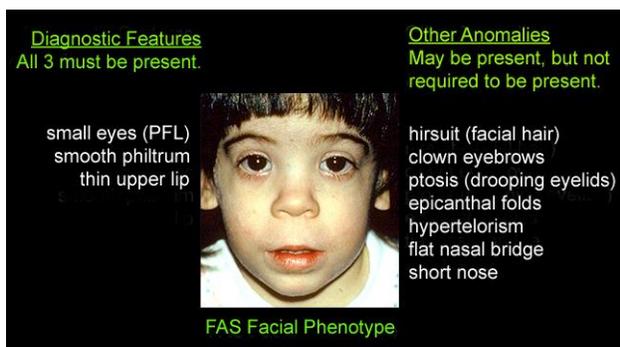
This Guide identifies key facial features (palpebral fissure length (PFL), philtrum, upper lip) and landmarks (endocanthion, exocanthion, orbitale, and tragus) used to measure the FAS facial phenotype. The child pictured has a normal facial phenotype. The Guide also provides a pictorial example of the Frankfort Horizontal Plane used to align the camera with the face. More detailed information about image rotation can be found elsewhere in this Instruction Guide.



Palpebral Fissure Length (PFL)

The palpebral fissure length (PFL) is defined as the distance from the endocanthion landmark to the exocanthion landmark.

The FAS Face and Other Anomalies Guide



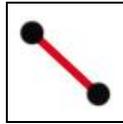
Pictorial examples of Diagnostic FAS facial features and other facial anomalies

To view: Select from the Guides drop-down menu on the top menu bar.

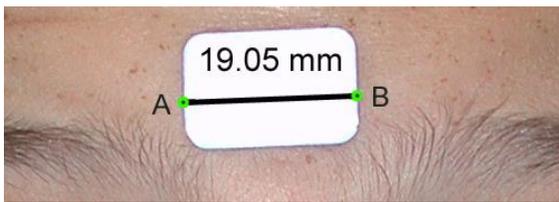
This young girl presents with the three facial features (listed on the left) that are diagnostic of the FAS facial phenotype. She also presents with other minor facial anomalies (listed on the right) that may or may not be present in an individual exposed to prenatal alcohol exposure. If other anomalies are present, they should be documented, but they are not used to diagnose the FAS facial phenotype.

Measuring the Internal Measure of Scale

The Single-Distance Tool



Single-Distance Tool Icon



Measuring the horizontal length of the internal measure of scale (or paper sticker).

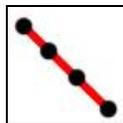
To use: Click the left mouse button on the image then click on the Single-Distance icon or select the tool from the TOOLS drop-down menu on the top menu bar.

This Tool measures the distance between two points. For example, to measure the length of the sticker on the forehead, click on the frontal photo, select the tool and highlight the “Length of Scale in Photo” cell in the Worksheet by clicking in it (the cell will turn pink). Now click and release the left mouse button on point A and click and release the left mouse button on point B. A straight line will be drawn on the photo as an overlay. The sticker length, in units of pixels, will automatically fill into the Worksheet cell.

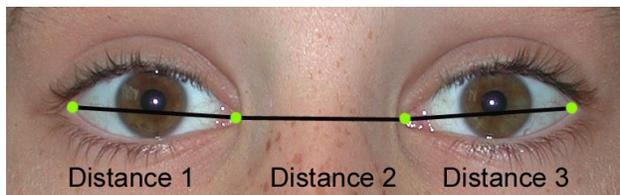
When measuring the internal measure of scale, its horizontal length should be measured, not its vertical height.

Measuring PFLs and Inner Canthal Distance

The 3-Distances Tool



3-Distances Tool Icon



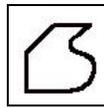
With the 3-Distances Tool, you can measure these 3 distances (the subject’s Right PFL, Inner Canthal Distance and Left PFL) with the following 4 mouse-clicks on the subject’s R. exocanthion, R. endocanthion, L. endocanthion and L. exocanthion.

To use: Click the left mouse button on the image, then click on the 3-Distances icon or select the tool from the TOOLS drop-down menu from the top menu bar.

For expediency and accuracy, this Tool measures three distances (R. PFL, Inner Canthal Distance and L. PFL) with just 4 mouse clicks. When the tool is selected, the Worksheet cell for R. PFL is automatically highlighted. Click and release the left mouse button on the patient’s R. exocanthion, R. endocanthion, L. endocanthion and L. exocanthion, in that order. The length in units of pixels for each feature will be automatically displayed in the proper cells on the Worksheet. The true length in mm and z-score of each feature will also be automatically computed if the following cells are filled in: birth date, photo date, normal chart race, gender, real scale length and length of scale in photo.

Measuring Lip Thinness

The Circularity Tool



Circularity Icon



An example of the upper lip outlined to compute circularity. This is the most accurate method for measuring upper lip thinness.

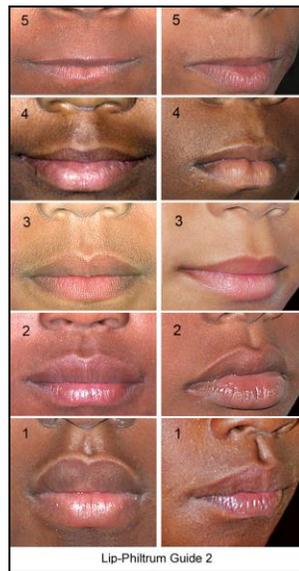
To use: Click the left mouse button on the image, then click on the Circularity Icon or select from the TOOLS drop-down menu from the top menu bar.

This Tool measures the circularity (or thinness) of the upper lip in the frontal photo. $Circularity = \frac{perimeter^2}{area}$. The thinner the upper lip, the greater the circularity. When the tool is activated, the user outlines the upper lip while holding the left mouse button down. The left mouse button is released when the outline is complete. Circularity is automatically computed, ranked and inserted into the proper cell of the worksheet. Circularity is a more accurate and objective method for computing lip thinness than simply selecting the picture on the Lip-Philtrum Guide below that best matches the lip in the patient's facial photograph.

The Lip-Philtrum Guides



Guide 1



Guide 2

To use: Two Guides are available. Guide 1 is used for Caucasians and all other races with lips similar to Caucasians. Guide 2 is used for Blacks and all other races with thicker lips like Blacks. Select a Guide from the GUIDES drop-down menu from the top menu bar. When displayed, place the mouse cursor on the guide and hold the left button down to move the Guide over the surface of the facial photograph.

These guides serve as pictorial 5-point Likert Scales for visually ranking upper lip thinness. The user selects the lip rank that best matches the lip thickness in the patient's facial photograph. The Rank of each lip is printed to the left of the each lip photo. The circularity of each lip pictured is printed in a Table on the backside of the Lip-Philtrum Guides. These Tables are reproduced here.

Lip Rank	Lip Circularity	
	Pictured	Range
5	178	≥ 131.5
4	85	75.5 to 131.4
3	65	57.5 to 75.4
2	50	42.5 to 57.4
1	35	≤ 42.5

Table on backside of Lip-Philtrum Guide 1.

Lip Rank	Lip Circularity	
	Pictured	Range
5	80	≥ 62.1
4	57	52.1 to 62.0
3	39	30.1 to 52.0
2	29	27.5 to 30.0
1	25	≤ 27.5

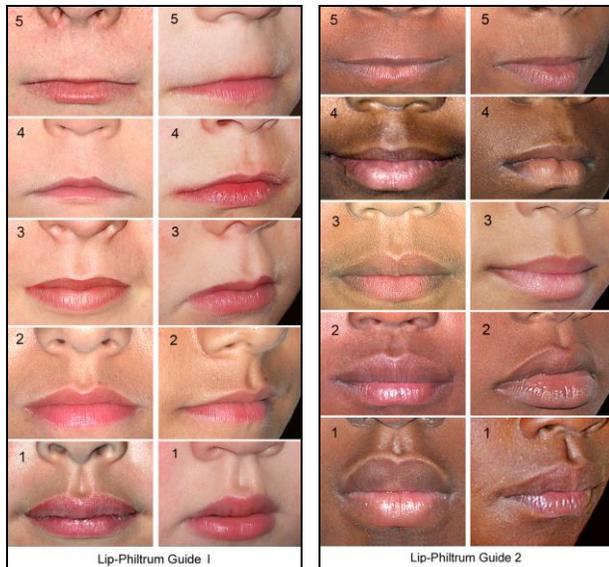
Table of backside of Lip-Philtrum Guide 2.

The range of circularity for each Rank is printed in a Lip Circularity Table on the backside of the Lip-Philtrum Guides. Note the ranges differ by race.

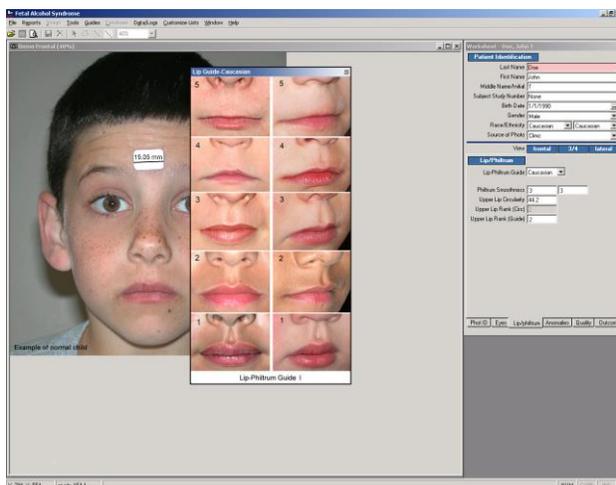
The most accurate measure of lip thinness is obtained using the circularity tool.

Measuring Philtrum Smoothness

The Lip-Philtrum Guides



Guides for ranking lip thinness and philtrum smoothness.



The Lip-Philtrum Guides can be opened and moved around across the top of the facial image. If the Guide happens to disappear behind the facial image on the computer screen, simply click on “Window” in the top Menu bar and click on the name of the Guide to bring it back in view.

To use: Select from the GUIDES drop-down menu from the top menu bar. When displayed, place the mouse cursor on the guide and hold the left button down to move the Guide over the surface of the facial photograph.

The guides provide a pictorial 5-point Likert Scale for visually ranking philtrum smoothness. The user selects the philtrum that best matches the philtrum in the patient’s facial photograph. The rank of the philtrum is printed on the left.

Note that there are two Lip-Philtrum Guides (1 and 2). The philtrum ranks are identical between the two Guides. In other words, the Rank 3 philtrum pictured in Guide 1 is the same depth as the Rank 3 philtrum pictured in Guide 2.

A Rank 5 philtrum is completely smooth. A Rank 4 philtrum is a barely visible indentation that typically must be viewed at an angle to detect. Go to our fasdpn.org website for additional photo examples of Rank 4 and 5 philtrums. A Rank 3 philtrum is the population mean. A Rank 1 philtrum is extremely deep with very prominent philtral ridges. A Rank 1 philtrum will be almost as rare in the population as a Rank 5 philtrum.

Lip thinness and philtrum smoothness are measured independently of one another. In other words, an individual can have a Rank 5 upper lip with a Rank 1 philtrum.

Guide for Scoring the FAS Facial Phenotype

The following Tables are used to derive the facial ABC-Score and the facial 4-Digit Code Rank (Astley, 2004; Astley & Clarren, 2000). These Tables serve as the case-definitions used to describe the full continuum of expression of the FAS facial features.

The user can view these tables by going to the Guides drop-down menu in the top menu bar. The user does not need to refer to these Tables to score the facial phenotype. The software automatically generates an ABC-Score and 4-Digit Diagnostic Code rank for the face when the user measures the palpebral fissure lengths, philtrum smoothness and upper lip thinness. These scores are presented at the end of the Worksheet under the OUTCOME tab.

Table 1A. Deriving the ABC-Score for the Face

The first step in deriving the 4-Digit Code rank for the facial phenotype is to derive the facial ABC-Score. For example, if a patient’s palpebral fissure lengths were 2 or more standard deviations below the norm (≤ -2 SD) and their philtrum and upper lip received Likert scores of 2 and 3 respectively, the facial phenotype would receive an ABC-Score of **CAB**.

5-Point Likert Scale for Philtrum & Lip	Z-score for largest Palpebral Fissure Length	Circle the ABC-Scores for:		
		Palpebral Fissure	Philtrum	Upper Lip
4 or 5	≤ -2 SD	<u>C</u>	C	C
3	> -2 SD and ≤ -1 SD	B	B	<u>B</u>
1 or 2	> -1 SD	A	<u>A</u>	A

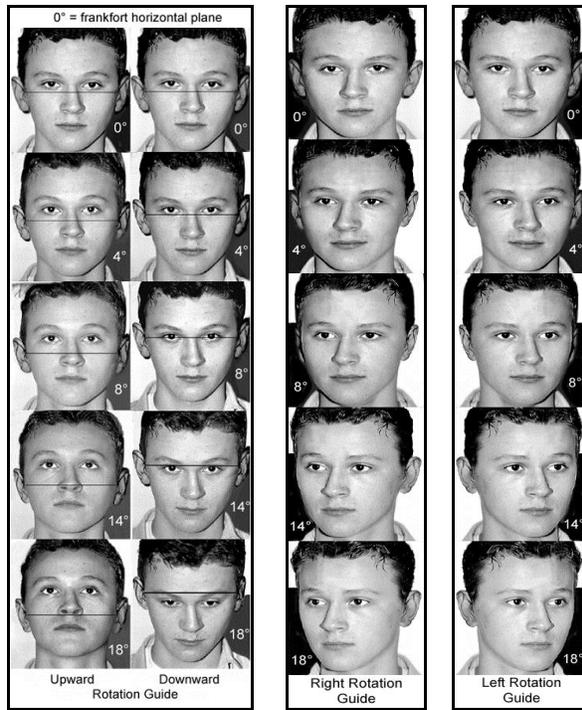
Table 1B. Deriving the 4-Digit Diagnostic Code Rank for the Face.

The final step is to convert the ABC-Score for Facial Phenotype to a 4-Digit Diagnostic Code Rank. A **CAB** score translates into a 4-Digit Diagnostic Code rank of **2**. This rank would serve as the second digit in the 4-Digit Diagnostic Code.

4-Digit Diagnostic Code Rank*	Level of Expression of FAS Facial Phenotype	Palpebral Fissure - Philtrum - Lip ABC-Score Combinations
4	Severe	CCC
3	Moderate	CCB, CBC, BCC
<u>2</u>	<u>Mild</u>	CCA, CAC, CBB, CBA, <u>CAB</u> , CAA BCB, BCA, BBC, BAC ACC, ACB, ACA, ABC, AAC
1	Absent	BBB, BBA, BAB, BAA ABB, ABA, AAB, AAA

Measuring the Rotation of the Facial Image

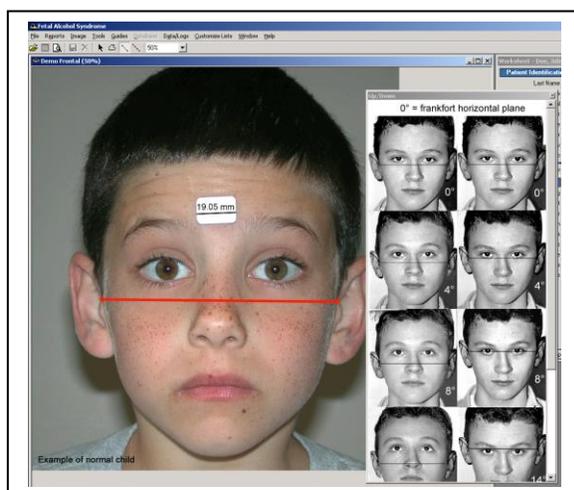
The Rotation Pictorial Guides



Up is (+)
Down is (-)

Right is (+)

Left is (-)



To view: Select from the GUIDES drop-down menu from the top menu bar. When displayed, place the mouse cursor on the guide and hold the left button down to move the Guide over the surface of the facial photograph.

These guides were obtained by placing the subject in a stereotaxic device to achieve accurate measures of rotation in degrees. The most accurate measures of facial features are made from a facial image that has no up, down, right or left rotation. These guides assist you in documenting the magnitude of rotation that may exist in the photograph.

Frontal Image: Ranking Up/Down Rotation

To rank the number of degrees the face in the frontal image is rotated up or down from the Frankfort Horizontal Plane, use the single-distance tool to draw a line from the top of the right tragus to the top of the left tragus in the patient's frontal photograph. See lower left image on this page and the Landmark/Rotation Guide pictured on next page. Compare the position of this line to the position of the lines drawn on the facial images in the Up/Down Rotation Guide. As the face is rotated up the line moves down toward the tip of the nose. As the face is rotated down the line moves up toward the eyebrows. Record your best estimate of the number of degrees of rotation up or down in the proper cell in the Worksheet. You may type in any degree of rotation from -45 to +45 in the cell. You are not restricted to the 5 levels of rotation presented in the Guide.

Frontal Image: Ranking Left/Right Rotation

Use these guides to assist you in judging the number of degrees the subject's head is rotated to their right (+) or their left (-). Record your best estimate of the number of degrees of rotation right or left in the proper cell in the Worksheet. You may type in any degree rotation from -45 to +45 in the cell. You are not restricted to the 5 levels of rotation presented in the Guide.

PART V. ANALYZING AN IMAGE

Example of a Complete Analysis and Outcome Report



Standardized Photo Set
This is a child with normal facial features.

An example of a complete analysis and outcome report on the Standardized Photo Set pictured to the left is available for your review. This example is of a child with normal facial features.

FAS Facial Photographic Analysis Report

Name: John T. Doe		First Middle Last	
Subject ID: None		Source of Photo: Clinic	
Gender: Male		Race: Caucasian/Caucasian	
Birth Date: 1/1/1990			

Normal PFL Chart: Scandinavian (Stronland '99)	Lip-Philtrum Guide: Caucasian	PHOTO ASSESSMENT	
Normal ICD Chart: Caucasian (Hall '99)	Frontal	3/4 View	Lateral
File Name: Demo Frontal	Demo 3/4	Demo Lateral	
Date of Photo: 6/22/1998	6/22/1998	6/22/1998	
Age (yrs) in photo: 8.47	8.47	8.47	
Date of Photo Assessment: 6/22/1998	6/22/1998	6/22/1998	
Photo Assessor: Astley	Astley	Astley	
Length of Real Internal Measure of Scale (sticker) placed on forehead (mm): 19.05		Length of Internal Measure of Scale in Frontal Photo (pixels): 155.2	
Left Palpebral Fissure Length: In photo (pixels) 208.5	True Length (mm) 28.2	Z-score -1.04	
Right Palpebral Fissure Length: In photo (pixels) 205.5	True Length (mm) 27.7	Z-score -0.87	
Mean Palpebral Fissure Length: In photo (pixels) 207.0	True Length (mm) 28.0	Z-score -0.86	
Inner Canthal Distance (ICD): In photo (pixels) 200.0	True Distance (mm) 24.5	Z-score -2.22	
Flat Philtrum (5-point rank): In Frontal Photo 3		In 3/4 Photo 3	
Thin Upper Lip: Circularity (perimeter ² /area) 44.2	5-Point rank (Circ) 2	5-Point rank (Scale) 2	
clown eyebrows <input type="checkbox"/> ptosis <input type="checkbox"/> strabismus <input type="checkbox"/> epicanthal folds <input type="checkbox"/> flat midface <input type="checkbox"/> protruding ears <input type="checkbox"/> flat nasal bridge <input type="checkbox"/> hypertelorism <input type="checkbox"/>			
Other anomalies present: <u>hypotelorism</u>			
Comments: Other syndromes present: <u>None reported</u>			

PHOTO QUALITY			
	Frontal	3/4 View	Lateral
Side showing	Right	Left	
Head rotation (5-point rank/score) to subject's Right (+) or Left (-)	g*	g	g
Head tilt (5-point rank) toward subject's Right (+) or Left (-) shoulder	g*	g	g
Head tilt (degrees) Up (+) or Down (-) from Frankfurt Horizontal Plane	g*	g	g
Exposure (5-point rank)	1 (good)	1 (good)	1 (good)
Focus (5-point rank)	1 (good)	1 (good)	1 (good)
Facial Expression (5-point rank)	1 (very good)	1 (very good)	1 (very good)
Reliability of ABC-Score for palpebral fissure length (5-point rank)	1 (very good)	1 (very good)	1 (very good)
Reliability of ABC-Score for philtrum (5-point rank)	1 (very good)	1 (very good)	1 (very good)
Reliability of ABC-Score for upper lip (5-point rank)	1 (very good)	1 (very good)	1 (very good)

OUTCOME			
ABC-Score	A	B	A
	PFL	Philtrum	Up
Data Used	mean	3/4 view	circularity
4-Digit Diagnostic Code for Face: 1: FAS features absent			

University of Washington FAS DPN FAS Facial Photographic Analysis Software © 2016

To Use: Select File/Open/Existing Subject File from the top menu bar. Double-click on the file named John Doe. Click on the OK button. The frontal, 3/4 and lateral facial photos and completed Worksheet will appear for your review and practice. To view the Report, select Reports from the top menu bar. Check the box for the subject named John Doe. Press the Preview button. To print the Report, click on the Print icon on the Tool Bar.

All data in this Sample Case are write-protected so you cannot save any changes you make to the Worksheet or Report.

This Sample Case also serves as a practice case for you. See below for more detailed instructions on how to use this Sample Case as a Practice Case.

Outcome Report

Opening an Image and Worksheet

To Open a New Photo

To Open a New Photo: Select File / Open / Photo from the top menu bar. Navigate through your hard drive to locate the image file you want to measure. Double-click on the image file. A blank Worksheet will automatically open when an image is opened. The Worksheet will not appear if an image is not open.

Typically, you will be analyzing a set of 3 photos (frontal, $\frac{3}{4}$, and lateral) for each patient. You will find it most efficient to open all three photos before beginning the analysis. You can toggle between the three opened photos by clicking on *Window* in the top menu bar and clicking on the image filename you want to view. More efficiently, once the file names of the 3 photos are entered into the Worksheet, you can click on the blue View banner in the Worksheet labeled Frontal, $\frac{3}{4}$ and Lateral, just below the Patient Identification section, to view each photo. You may also view all photos at one time by clicking on *Window* in the top menu bar and selecting *Tile Images*.

To Open an Existing Subject File

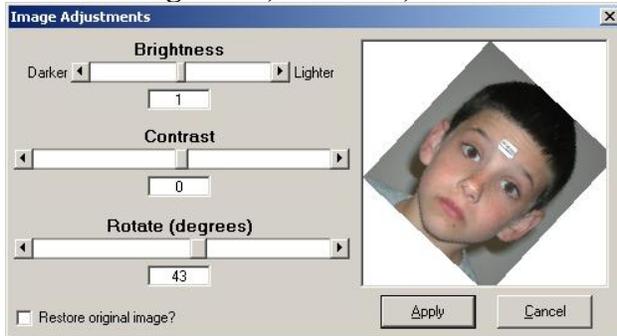


Sample photos of a normal child.

To Open an Existing Subject File: Select File / Open / Existing Subject File from the top menu bar. Double-click on the subject's name to highlight it. Then click the OK button. A Worksheet will automatically open with data saved from the previous saved analysis.

Enhancing the Image

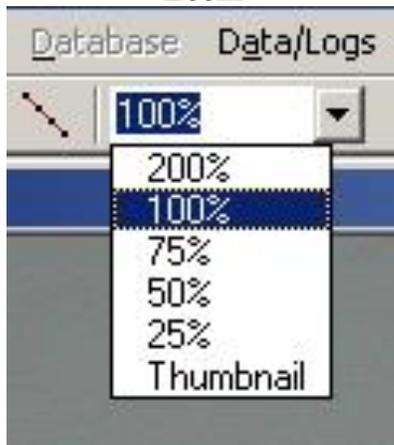
Brightness, Contrast, Rotate



To Use: First open an image. Then select Image / Image Adjustments from the top menu bar.

To adjust *Brightness, Contrast or Rotation* of the image, either slide the control bar from left to right, left-click on the arrows at either end of the slide or type in a positive or negative number in the box below the slide.

Zoom



To Use: First open an image. Then select Image / Zoom from the top menu bar to select a magnification % from the drop-down list or Select a magnification % directly from the drop-down list on the tool bar. You may also type in any incremental number (without a % sign) into the cell next to the down arrow to select intermediate magnification. For example, if you typed 35 in the cell, the image would be presented at 35% magnification. An hour-glass will appear as the magnified image is being generated.

If the image disappears when you enlarge it, you have enlarged it beyond what your video driver can handle. This may occur with very large photos. If this occurs, reduce the zoom incrementally until the image re-appears

Clear overlays



To Use: First open an image. Then select Image / *Clear Overlays* from the top menu bar. All distance and circularity measurements drawn on the image as temporary overlays will be removed.

Analyzing an Image Recording Data on a Worksheet

Patient Identification Section of Worksheet

Worksheet - Doe, John T

Patient Identification

Last Name: Doe

First Name: John

Middle Name/Initial: T

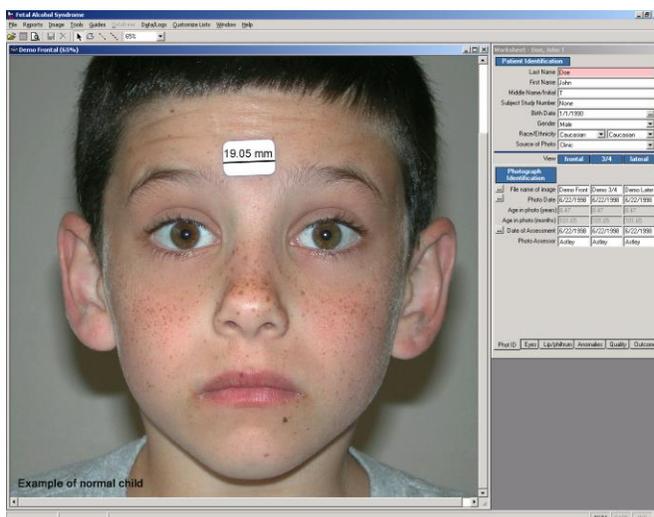
Subject Study Number: None

Birth Date: 1/1/1990

Gender: Male

Race/Ethnicity: Caucasian

Source of Photo: Clinic



To view: To open a Worksheet, you must first open an image. The Patient Identification section of the Worksheet is always visible when a Worksheet is open. The cell highlighted in pink is the active cell waiting for data entry.

When an image is opened, the image will appear on the left side of the monitor and a blank Worksheet will open on the right side of the monitor.

The first section of the worksheet is labeled: Patient Identification.

Complete the information by either typing directly into the cells or selecting drop-down menus with the down-arrow.

Dates: Dates can be selected from a calendar by pressing the button on the date line. Click on the calendars year to reveal additional arrows for increasing or decreasing the year. When the correct date is selected, close the calendar and the date will appear in the Worksheet cell. You can also just type the date in the cell. Important: ensure your computer's "Regional Date Setting" is set to English (United States) (mm/dd/yyyy format). See instructions on our website fasdpn.org

Race: Each patient is identified by two races (one for each parent). For example, if both parents are Caucasian, race would be coded Caucasian, Caucasian. If one parent is Caucasian and one is Black, race would be coded Caucasian, Black. Additional races can be added to the drop-down lists by selecting the Customized Lists button on the top menu bar.

Source of Photo: You may want to document the source of the photo (i.e., clinic, research, etc). You can customize the Source of Photo list by selecting the Customized Lists button on the top menu bar.

Photo Identification Section of Worksheet

View		frontal	3/4	lateral
Photograph Identification				
...	File name of image	Demo Front	Demo 3/4	Demo Lat
...	Photo Date	6/22/1998	6/22/1998	6/22/1998
	Age in photo (years)	8.47	8.47	8.47
	Age in photo (months)	101.65	101.65	101.65
...	Date of Assessment	6/22/1998	6/22/1998	6/22/1998
	Photo Assessor	Astlev	Astlev	Astlev
Phot ID Eyes Lip/philtrum Anomalies Quality Outcome				

Once the 'File Name of Image' is entered into the cells for the frontal, 3/4 and lateral images, you can click on the BLUE frontal, 3/4 and lateral View buttons shown above to view each of those images or toggle back and forth between them.

To View: Select the Photo ID tab at the bottom of the Worksheet.

Photo View: The information requested for the frontal, 3/4 and lateral images are presented in the 1st, 2nd and 3rd columns respectively.

File name of image: This is the name you assigned to the electronic facial image. The name of the image file can be typed into the cell or automatically filled in by clicking the mouse in the data cell, (which makes the field active or pink), and then clicking on the opened image. The name of the image file will automatically enter into the active cell. An expedient way to open the three images and enter their filenames automatically into the File Name of Image cells is to 1) open the frontal image and click on the 'File Name of Image' cell for the frontal image. Next, open the 3/4 image and click on the 'File Name of Image' cell for the 3/4 image. Next, open the lateral image and click on the 'File Name of Image' cell for the lateral image.

Photo Date: This is the date the photo is taken. This date will be used to automatically compute the age of the patient in the photo from the patient's birth date. Your computer's 'Regional Date Setting' must be set to English (United States) for proper age computation (see fasdpn.org for details).

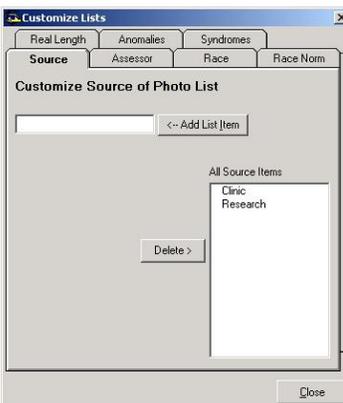
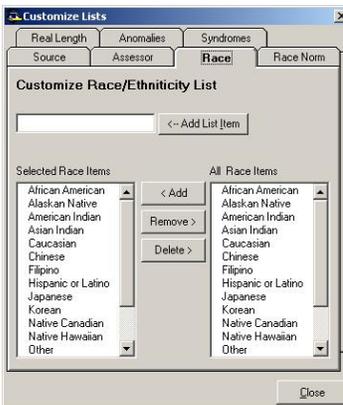
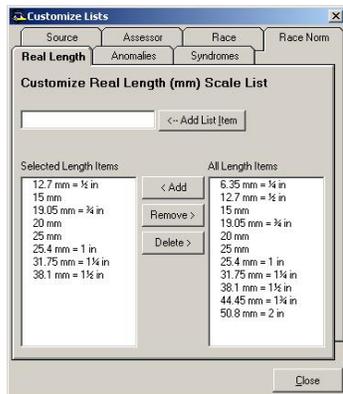
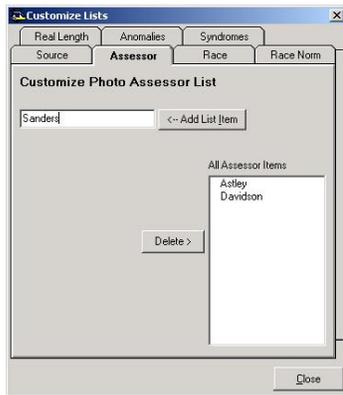
Age in Photo: Age in years and months are grayed out to indicate they will be automatically computed when the birth date and photo date are entered.

Date of Assessment: This is the date the photograph is being analyzed.

Photo Assessor: This is the name of the person analyzing the photo. This drop-down list can be customized by selecting Customized Lists from the top menu bar.

Quick Tip: If the photo date, date of assessment and photo assessor are the same for each image, enter this information for the frontal image, then just click on the Photo Date cell for the 3/4 and lateral images and all information from Photo Date to Photo Assessor will automatically fill into the cells.

Customizing Lists



To View: Select “Customize List” from the top Menu Bar.

Each of the following lists can be updated to include additional entries.

Real Length of the internal measure of scale (sticker)

Anomalies

Syndromes

Source of image

Assessor of image

Race of subject

Race Norms for palpebral fissure lengths

To update a list,

1. Click on the appropriate Tab (Lets use Assessor as an example).
2. Type in the new entry in the cell next to “Add List Item”. We typed in the name Sanderson.
3. Click on the “Add List Item” button. This will add the name Sanderson to our list of assessors.
4. Click on the “Close” button.

The Race Norms tab is currently inactive. Please refer to the section below entitled “**Importing New Racial Calculations for PFL Z-scores**” for instructions on how to import the new Canadian and Scandinavian PFL formulas. In future versions of this software, additional racial norms for palpebral fissure lengths may be added as norms are established. Currently, racial norms are available for Caucasian (Hall et al., 1989), Canadian (Clarren et al., 2010; Scandinavian (Stromland et al., 1999; and African American (Iosub et al., 1985) palpebral fissure lengths.

Selection of the proper PFL grow charts is very important. The Iosub charts should be used for African Americans. We recommend the Stromland charts for Caucasians. See our website fasdnpn.org for more details on which PFL growth charts to use.

Eyes Section of Worksheet

When the Caucasian, Canadian, or Scandinavian Normal PFL Charts are selected, the z-score for Inner Canthal Distance (ICD) is computed using the Hall (1989) normal charts. Z-scores require birth date, photo date, and gender to be entered because all z-scores are age dependent and some are gender dependent.

When the African American Normal PFL Chart is selected, PFL z-scores require birth date, photo date, and gender to be entered. Inner Canthal Distance z-scores are not available for African Americans.

To View: Select the Eyes tab at the bottom of the Worksheet. All eye measurements are obtained from the frontal image.

Only data fields in white are to be filled-in by you. Click the mouse cursor in a white cell to enter data. It will turn pink to designate it is the active cell. Gray fields are computed automatically.

Normal Chart Race: Select the race that best matches the most predominant race of the patient. This selection determines which normal anthropometric chart is used to compute PFL z-scores. Four racial selections are available in Version 2: Caucasian (Hall et al, 1989); Canadian (Clarren et al., 2010), Scandinavian (Stromland et al., 1999), and African American (Iosub et al., 1985). Inner Canthal Distance normal charts are only available for Caucasian (Hall et al., 1989). See our website (fasdpn.org) for guidance on which PFL charts to use.

Real Scale Length: Select the real length of the internal measure of scale (sticker) placed on the patient's forehead. This list can be customized by selecting Customized List from the top menu bar.

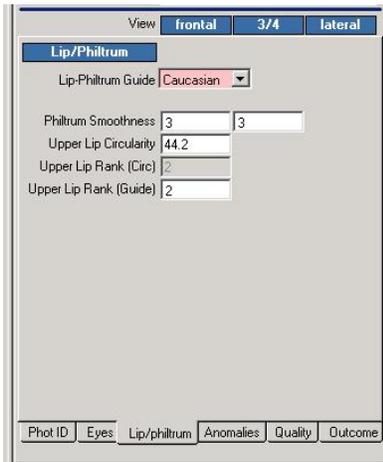
Length of Scale in Photo: This is the horizontal length of the sticker measured in units of pixels using the Single-Distance tool. First click on the image, then click on the Single-Distance Tool, then click on the Length of Scale in Photo cell (it will turn pink when selected), then measure the length of the sticker. See direction above under Single-Distance Tool.

The remaining three data fields are measured using the 3-Distances Tool.

Patient's Right PFL: ___ (pixels)
Inner Canthal Distance: ___ (pixels)
Patient's Left PFL: ___ (pixels)

When this tool is selected, data will automatically enter into the R. PFL, Inner Canthal Distance and L. PFL cells in that order, thus they must be measured in that order. With the left mouse button, click on the patient's R. exocanthion, R. endocanthion, L. endocanthion and L. exocanthion in that order. The gray cells will compute automatically based on the birth date, photo date, gender and the race of the normal anthropometric chart selected.

Lip / Philtrum
Section of Worksheet



Guide 1



Guide 2

To View: Select the Lip/Philtrum tab at the bottom of the Worksheet.

Photo View: The information requested for the frontal and 3/4 images are presented in the 1st and 2nd columns respectively. You can conveniently view the frontal, 3/4 and lateral images by clicking on the Blue frontal, 3/4 and lateral View buttons.

Lip-Philtrum Guide (Race): Use the drop-down menu to select which Lip-Philtrum Guide is most appropriate to use based on the subject's race(s). Guide 1 is for Caucasians and races with lips like Caucasians. Guide 2 for Blacks and races with thicker lips similar to Blacks.

Philtrum Smoothness: Open a racially appropriate Lip-Philtrum Guide by clicking on GUIDES in the top menu bar. Use this Guide to select which rank on the 5-Point Scale best matches the philtrum smoothness in the patient's frontal and 3/4 photos. Philtrum smoothness is most accurately measured from the 3/4 view photo. Assign the same philtrum rank for the 3/4 and frontal photos. You can move the Guide across the patient's photos by placing the mouse cursor on the Guide and holding the left mouse button down and dragging.

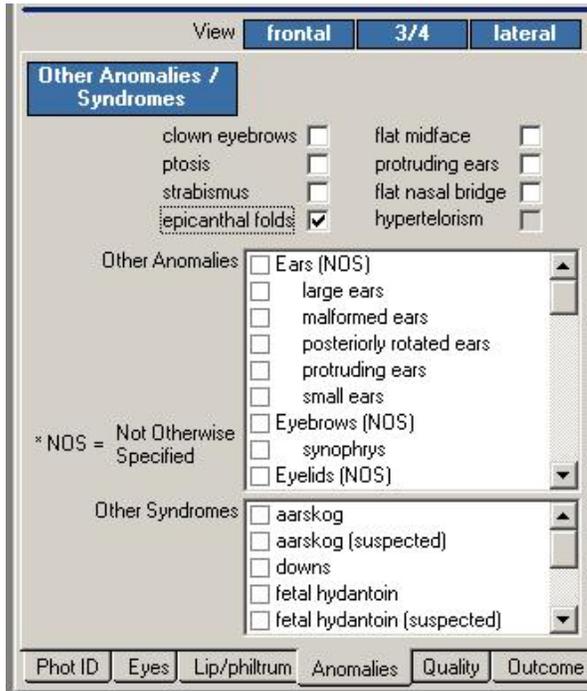
Upper Lip Circularity: Upper lip thinness is most accurately measured using the Circularity Tool. Open the Circularity Tool from the tool bar and measure lip circularity in the frontal photo as instructed above under the Lip Circularity Tool. The circularity of the lip will automatically enter into this field.

Lip thinness is ranked on a 5-Point scale. There are two ways to achieve this: 1) compute the rank automatically from the circularity or 2) judge the rank based on the best pictorial match on the Lip-Philtrum Guide. You will have the option of selecting which method you want to use for ultimately scoring the face under the Outcome Tab.

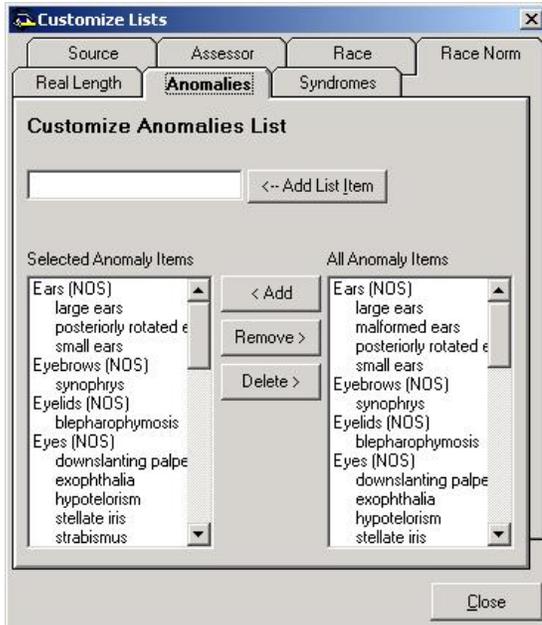
Upper Lip Rank (circularity): The Rank of the upper lip thinness will be automatically computed from the circularity measure and entered into this grayed-out cell. The Rank will be based on which racial Lip-Philtrum Guide you selected. Note, if you toggle between the two Guides, the Rank based on circularity will update to reflect which Guide is selected.

Upper Lip Rank (guide): Use the Lip-Philtrum Guide to select which picture on the 5-Point Scale best matches the lip thinness in the patient's photograph.

Other Anomalies / Syndromes Section of Worksheet



To record which anomalies/syndromes are present in an individual subject.



To add new anomalies or syndromes to the list presented under the Anomalies Tab in the Worksheet.

To Use: Select the Anomalies tab at the bottom of the Worksheet.

Anomalies: Place a ✓ in the box next to the anomaly(ies) that the patient has. This list can be customized to include additional anomalies. Go to Customized Lists on the top menu bar and select the Anomalies tab. The additional anomalies you add to the customized list will appear at the end of the Other Anomalies List in the Worksheet. Hypertelorism will automatically get checked if the z-score for the inner canthal distance is $\geq + 2.0$. Hypotelorism will automatically get checked if the z-score for the inner canthal distance is ≤ -2.0 .

Syndromes: Place a ✓ in the box next to any other syndromes that are known or suspected to be present. This list can be customized to include additional syndromes. Go to Customized Lists on the top menu bar and select the Syndromes Tab. The additional syndromes you add to the customized list will appear in alphabetical order in the Other Syndromes list on the Worksheet.

Photo Quality Section of Worksheet

View	frontal	3/4	lateral
Photo Quality			
Side showing		Right	Left
Head turned right/left	0	0	0
Head tilt toward shoulder			0
Head tipped up/down	0		
Exposure	1	1	1
Focus	1	1	1
Facial Expression	1	1	1
Reliable PFL score	1		
Reliable philtrum score	1	1	
Reliable upper lip score	1		
Comments	<input type="text"/>		
<input type="button" value="Phot ID"/> <input type="button" value="Eyes"/> <input type="button" value="Lip/philtrum"/> <input type="button" value="Anomalies"/> <input type="button" value="Quality"/> <input type="button" value="Outcome"/>			

To View: Select the Quality tab at the bottom of the Worksheet.

Photo Quality

The quality of a photo will impact the accuracy of the facial measures. The quality of the photo should be taken into consideration when rendering a clinical decision. Photos of poor quality should not be used.

It is recommended that you take some practice photos of a person with widely varying quality (severe rotation, big smile, eyes not fully open, etc) and compare the measures you obtain from those photos with the measures you obtain from a high quality photo of the same individual. This will give you a good idea how much the quality of a photo can impact measurement accuracy.

Photo View: The information requested for the frontal, 3/4 and lateral images are presented in the 1st, 2nd and 3rd columns respectively. Not every column requires information.

Side Showing: Record whether the right or left side of patient's face is showing in the 3/4 and lateral photos.

Head Turned Right / Left in Frontal Image: Use the drop-down menu to record how many degrees the patient's face is rotated toward their right (+) or left (-) in the frontal photo. Use the Right and Left Rotation Pictorial Guides to assist you. You may type in any whole number degree rotation from -45 through +45.

Head Turned Right / Left in 3/4 Image: Use the drop-down menu to record how much (on a 5-point scale) the patient's face is rotated toward their right (+) or left (-) in the 3/4 photo. There is no pictorial guide to assist you. Mild rotation implies the amount of rotation present will have only a small impact on the accuracy of the measures obtained from that image. Severe rotation implies the amount of rotation present will have a marked impact on the accuracy of the measures obtained from that image. A 3/4 view photo that is rotated too far right or left could impact your ability to accurately measure the smoothness of the philtrum.

Photo Quality Section of Worksheet

(Continued)

View	frontal	3/4	lateral
Photo Quality			
Side showing		Right	Left
Head turned right/left	0	0	0
Head tilt toward shoulder			0
Head tipped up/down	0		
Exposure	1	1	1
Focus	1	1	1
Facial Expression	1	1	1
Reliable PFL score	1		
Reliable philtrum score	1	1	
Reliable upper lip score	1		
Comments	<input type="text"/>		
Phot ID	Eyes	Lip/philtrum	Anomalies
Quality	Outcome		

Head Turned Right / Left in Lateral Image: Use the drop-down menu to record how much (on a 5-point scale) the patient's face is rotated toward their right (+) or left (-) in the lateral photo. There is no pictorial guide to assist you. Mild rotation implies the amount of rotation present will have only a small impact on the accuracy of the measures obtained from that image. Severe rotation implies the amount of rotation present will have a marked impact on the accuracy of the measures obtained from that image. The measure most likely to be impacted is flat midface. A lateral photograph of the left side of the face that is rotated toward the subject's left will make the midface appear flatter than it truly is. If the same photo was rotated to the subject's right, the midface would appear less flat than it truly is.

Head Tilt Toward Shoulder in Lateral Image: Use the drop-down menu to record how much (on a 5-point scale) the patient's head is tilted toward their left or right shoulder. There is no pictorial guide to assist you. Mild rotation implies the amount of rotation present will have only a small impact on the quality of the measures obtained from that image. Severe rotation implies the amount of rotation present will have a marked impact on the quality of the measures obtained from that image. The measure most likely to be impacted is flat midface.

Head Tipped Up / Down in Frontal Image: Use the drop-down menu to record how many degrees the patient's face is tipped up or down in the frontal photo. Use the Up/Down Rotation Pictorial Guide to assist you. You may type in any degree of rotation from -45 through +45 using your best judgement.

Exposure: Use the drop-down menu to record on a 3-point scale if the photo has good exposure, is a bit light/dark or is too light/dark.

Focus: Use the drop-down menu to record, on a 3-point scale, if the photo has good focus, is a bit blurry or is too blurry.

Photo Quality Section of Worksheet

(Continued)

View	frontal	3/4	lateral
Photo Quality			
Side showing	Right	Left	
Head turned right/left	0	0	0
Head tilt toward shoulder			0
Head tipped up/down	0		
Exposure	1	1	1
Focus	1	1	1
Facial Expression	1	1	1
Reliable PFL score	1		
Reliable philtrum score	1	1	
Reliable upper lip score	1		
Comments	<input type="text"/>		
Phot ID	Eyes	Lip/philtrum	Anomalies
Quality	Outcome		

Facial Expression: Use the drop-down menu to record, on a 3-point scale, if the facial expression is relaxed, has a mild facial expression or a severe facial expression. Facial expressions (like a big smile or eyes that are not fully open) can impact measurement accuracy. The goal is to have a relaxed face.

Reliable PFL, Philtrum and Upper Lip Scores. Use the drop-down menus to record, on 5-point scales, if the quality of the photographs leads to reliable ABC and 4-Digit scores for each of these three diagnostic features.

Comments: Enter any comments you wish to have recorded in the database and Outcome Report.

Outcome Section of Worksheet

Data used to generate ABC-Score			
mean PFL	3/4 view	circularity	
Outcome			
ZScore/Rank of Feature	-0.07	3	2
Facial ABC-Score	A	B	A
Facial 4-Digit Code Rank	1: FAS features absent		

When you have completed the photo analysis of this patient, select what you would like to do next:

Save the data in the worksheet to the database.
 Preview or print the outcome report.
 Begin analysis of a new patient/photo.
 Begin analysis of a patient with existing subject info.
 Close the software.

Go

Phot ID | Eyes | Lip/philtrum | Anomalies | Quality | Outcome

To Use: Select the Outcomes tab at the bottom of the Worksheet.

Outcome: This last section provides the final scores for the facial phenotype.

Data used to generate ABC-Score: You have the option of selecting which data you would like to use to generate the Facial ABC-Score and 4-Digit Rank. For example, click on the mean PFL cell and note that you can select R.PFL, L.PFL or mean PFL from a drop-down menu. Your selection should be based on which source of information provided you with the most accurate data.

Eyes: You have the option to select the mean PFL, right PFL or left PFL to generate the z-score. The mean PFL is recommended because it will adjust for any right-to-left rotation that may exist in the photo. On rare occasion, the quality of the photo or a true asymmetry in the size of the right and left PFL requires that just the right or left PFL be selected rather than the mean. If there is a true asymmetry in the size of the two PFLs, (> 2 mm's) AND there is NO right-to-left rotation in the frontal image, choose the largest and/or most normal PFL rather than using the mean of the two PFLs.

Philtrum: You have the option to use the philtrum rank from the frontal or the ¾ view photo. Often the ¾ view provides a more accurate measure.

Upper lip: You have the option to have the upper lip be ranked from the circularity measure or from the best matched picture on the Lip-Philtrum Guide. Circularity is often the more accurate measure.

Z-score/Rank of Feature: The z-score or rank of each feature will automatically fill into the cell based on which source of data you chose to use to generate the ABC-Score.

Facial ABC-Score: This score is automatically computed. A is normal, B is moderately abnormal, C is abnormal. (See Astley, 2004a)

Facial 4-Digit Rank: This score is automatically computed. Rank 1= FAS features absent; Rank 2 = FAS features mild; Rank 3 = FAS features moderate; Rank 4 = FAS features severe. (See Astley 2004a)

Practice Image Set “John Doe”



This case, John Doe, serves as a Practice Case. This is an example of a normal child. The Identification data inserted in the Report is fictitious

To Use: Select File/Open/Existing Subject File from the top menu bar. Double-click on the file named John Doe. Click on the OK button. The frontal, ¾ and lateral facial photos and a completed Worksheet will appear for your review and practice. To view the Report, select Reports from the top menu bar. Check the box for the subject named John Doe. Press the Preview button. To print the Report, click on the Print icon on the Tool Bar.

The purpose of this practice case is to allow you to practice using the measurement tools to see if you can duplicate the outcomes of key measures like:

- Left PFL = 208.5 pixels
- Right PFL = 205.5 pixels
- Inner Canthal Distance = 200.0 pixels
- Internal Measure of Scale = 155.2 pixels
- Lip circularity = 44.2
- Philtrum smoothness = Rank 3

It is recommended you first print the report to use as a Guide, because once you start altering data in the Worksheet, your alterations will be reflected in the Report.

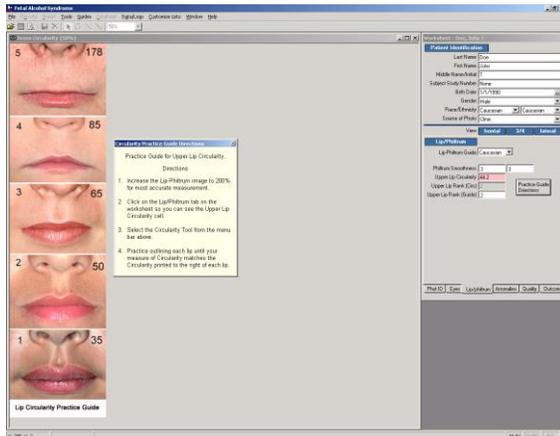
Even though you can alter the data in the Worksheet and Report, you will not be able to save the altered data. This will protect the Practice Case for future use and reference.

To refresh the Practice Case to its original data, go to the Outcome Tab on the Worksheet, select *Begin analysis of a patient with existing subject info* and click on GO. Double click on John Doe and press the OK button. A refreshed version of the Practice Case will appear on our screen.

FAS Facial Photographic Analysis Report			
			IDENTIFICATION
Name	John T	Date	
Subject I.D.	First Middle	Last	
Source of Photo	None	Clinic	
Gender	Male		
Race	Caucasian/Caucasian	Birth Date 11/11/990	
Normal PFL Chart: Scandinavian (Stromland '99)			PHOTO ASSESSMENT
Normal ICD Chart: Caucasian (Hall '89)			
File Name	Demo Frontal	¾ View	Lateral
Date of Photo	6/22/1998	6/22/1998	6/22/1998
Age (yrs) in photo	8.47	8.47	8.47
Date of Photo Assessment	6/22/1998	6/22/1998	6/22/1998
Photo Assessor	Astley	Astley	Astley
Length of Real Internal Measure of Scale (sticker) placed on forehead (mm) 19.05			
Length of Internal Measure of Scale in Frontal Photo (pixels) 155.2			
Left Palpebral Fissure Length:	In photo (pixels) 208.5	True Length (mm) 28.2	Z-score 1.04
Right Palpebral Fissure Length:	In photo (pixels) 205.5	True Length (mm) 27.7	Z-score 0.67
Mean Palpebral Fissure Length:	In photo (pixels) 207.0	True Length (mm) 28.0	Z-score 0.86
Inner Canthal Distance (ICD):	In photo (pixels) 200.0	True Distance (mm) 24.5	Z-score -2.22
Flat Philtrum (5-point rank): In Frontal Photo 3 In ¾ Photo 3			
Thin Upper Lip: Circularity (perimeter/area) 44.2 5-Point rank (Circ) 2 5-Point rank (Scale) 2			
Other anomalies present: <input type="checkbox"/> down eyebrows <input type="checkbox"/> ptosis <input type="checkbox"/> strabismus <input type="checkbox"/> epicanthal folds <input type="checkbox"/> flat midface <input type="checkbox"/> protruding ears <input type="checkbox"/> flat nasal bridge <input type="checkbox"/> hypertelorism <input type="checkbox"/>			
Comments: Other syndromes present: None reported			
			PHOTO QUALITY
Side showing	Frontal	¾ View	Lateral
Head rotation (5-point rank) (degrees) to subject's Right (+) or Left (-)	0*	0	0
Head tilt (5-point rank) (degrees) toward subject's Right (+) or Left (-) shoulder	0*	0	0
Head up (degrees) Up (+) or Down (-) from Frankfurt Horizontal Plane	0*	0	0
Exposure (3-point rank)	1 (good)	1 (good)	1 (good)
Focus (3-point rank)	1 (good)	1 (good)	1 (good)
Facial Expression (3-point rank)	1 (very good)	1 (very good)	1 (very good)
Reliability of ABC-Score for palpebral fissure length (5-point rank)	1 (very good)	1 (very good)	1 (very good)
Reliability of ABC-Score for philtrum (5-point rank)	1 (very good)	1 (very good)	1 (very good)
Reliability of ABC-Score for upper lip (5-point rank)	1 (very good)	1 (very good)	1 (very good)
			OUTCOME
ABC-Score	A	B	A
Data Used	mean	¾ view	up
4-Digit Diagnostic Code for Face 1: FAS; features absent			
University of Washington FAS DPN FAS Facial Photographic Analysis Software © 2016			

Practice Case Report for John Doe

Circularity Practice Guide



Circularity Practice Guide presented with the Directions visible and the Upper Lip Circularity cell highlighted pink.

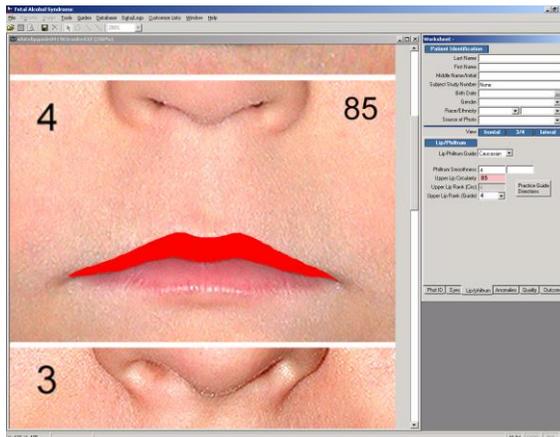


Image zoomed to 200% for measuring circularity.

To Use: Select Guides / Circularity Practice Guide from the top menu bar. The Lip-Philtrum Guide 1 will appear for you to practice outlining.

For Directions:

1. Click on the “Practice Guide Directions” button showing in the Lip/Philtrum window of the Worksheet.
2. Increase the Lip-Philtrum Guide to 200% for most accurate measurement.
3. Select the Circularity Tool from the top menu bar. Notice the Upper Lip Circularity cell is pink.
4. Practice outlining the red portion of the upper lip until your measure of circularity repeatedly matches the circularity printed to the right of each lip photo. Note that your outline should reach from the left to the right corners of the mouth.
5. Each time you select the Circularity tool to outline a lip; a window will appear alerting you that “There is already an upper lip circularity value. Do you want to overwrite it?” Say Yes.
6. To end the session, click on the Outcomes Tab at the bottom of the worksheet and click on “Begin analysis of new patient/photo”.

Tips:

Note that more accurate, reproducible measures can be achieved when the image is increased in size (up to 200% zoom). The circularity of the lip does not change with magnification, but your ability to outline it accurately will. Try measuring the same lip at 50%, 100% and 200% zoom to see for yourself.

Adjust your mouse tracking specifications to achieve maximum hand-mouse control.

Test your ability to outline the same lip and get the same circularity each time. See our website (fasdpn.org) for an animated example of lips being outlined.

Consider outlining a subject’s lip 2 or 3 times and taking the average across the multiple measures to obtain the most accurate measure of circularity.

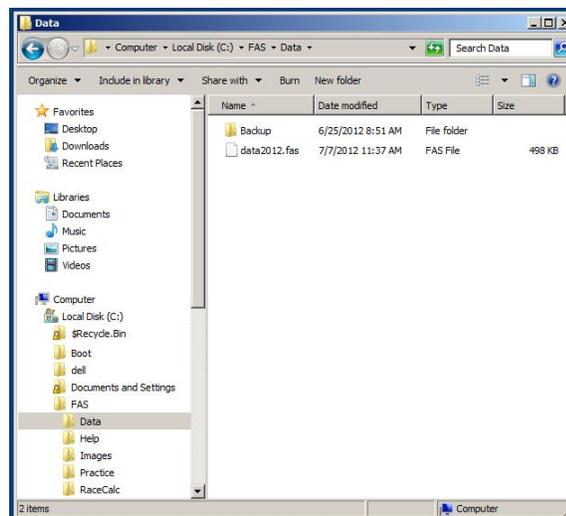
PART VI. SAVING / DELETING / EXPORTING THE DATA

The Facial Software Database

This software program comes with a Microsoft Access database that is specifically designed to store all photo analysis data displayed in the Worksheet, if you choose to save it. The database does NOT store the digital facial photos. Your digital photos are stored in a directory on your hard drive per your specifications. The Access database stores the path that locates where the digital photo was stored on your hard drive, at the time you saved the Worksheet. This stored path allows the database to retrieve the digital photo and display it in the Report, when you ask to view the Report. This stored path also allows the software to locate your photos if you choose to evaluate them again at a later date. The software will not be able to find and display the digital photos if you change their location on your hard drive after you saved the Worksheet data.

When you analyze a set of photographs for a patient, the data is displayed in the Worksheet. When you save the data in the Worksheet, it is saved as a single Record in the database, linked to the patient's last name, birth date, and the file names of up to three images (frontal, $\frac{3}{4}$ and lateral). If you analyze a second set of photographs for a patient, perhaps photos taken at a different age, this second Worksheet would be saved as a second record for that patient.

The Access database that stores the photo analysis data is named **data2012.fas** by default, when you install the software. Note that this database is saved on your hard drive under C:\FAS\data2012.fas. If you reload the software, an empty data2012.fas file will be installed and overwrite your existing data2012.fas file that contains all your photo analysis data. **Thus, it will be VERY important that you rename the data2012.fas file on your hard drive, and preferably copy the renamed file onto your desktop for safe keeping, before reinstalling the software.** Please see detailed directions for installing the software on our website fasdpn.org.



Saving the Data in the Worksheet to the Facial Software Database

eyes philtrum upper lip

Data used to generate ABC-Score

mean PFL 3/4 view circularity

Outcome

ZScore/Rank of Feature	-0.07	3	2
Facial ABC-Score	A	B	A
Facial 4-Digit Code Rank	1: FAS features absent		

When you have completed the photo analysis of this patient, select what you would like to do next:

Save the data in the worksheet to the database.
 Preview or print the outcome report.
 Begin analysis of a new patient/photo.
 Begin analysis of a patient with existing subject info.
 Close the software.

Go

Phot ID Eyes Lip/philtrum Anomalies Quality Outcome

There are two methods to save the data in the Worksheet to the Facial Software Database:

Method 1:

1. Click on the Outcome Tab at the bottom of the Worksheet
2. Click on “*Save the data in the worksheet to the database*”.
3. Click the “GO” button.

Method 2:

1. Highlight the Worksheet
2. Select *Database* from the top menu bar.
3. Select “*Save current worksheet data from database*”.

Deleting Data in the Database

To delete data from the Database:

1. Open the case you want to delete.
2. Click on the top border of the Worksheet.
3. Select *Database* from the top menu bar
4. Select *Delete current worksheet data from database*”.

Exporting Data from the Database

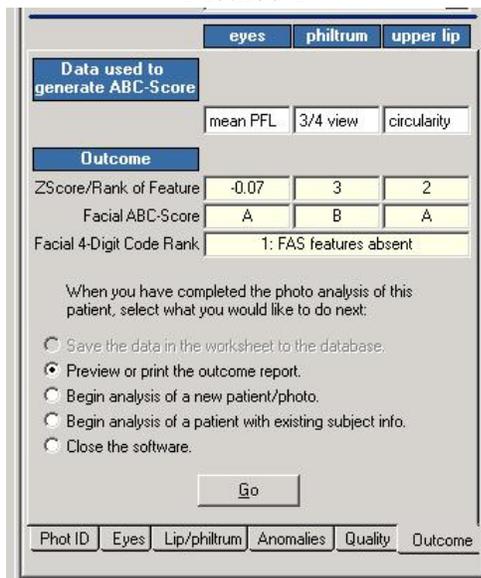
To export one or many patient records into a comma-delimited text file:

1. Select *File* from the top menu bar.
2. Select *Export Records*.
3. In the left window in the pop-up window that appears, browse to the directory where you would like to save the exported file. By default, the exported file will be placed in C:\FAS\Export directory.
4. In the *File Name* box, type in the name you would like to call the exported file. It will automatically be assigned ".txt" as an extension.
5. Click the *Save* button.
6. In the next window, you will see a list of patients whose records have been saved. Double-click on the patient you want to highlight it. If you want to select multiple patients, you may hold down the Ctrl key and click (highlight) as many names as you wish. If you want to select all of the patients, click on the first name, scroll down to the end of the list, hold down the Shift key, and click on the last name.
7. Click the *Export* button.

PART VII. VIEWING / PRINTING THE OUTCOME REPORT AND DATABASE MANAGEMENT

Viewing the Outcome Report

Method 1



There are two methods to view the Outcome Report.

1. Select the Outcome Tab and select “Preview or Print outcome report”

A copy of the current subject’s Outcome Report will appear.

Method 2



Selecting the current subject’s Report



Selecting a previous subject’s saved Report

2. Select Report from the top menu bar to open the “Print/Preview Options” window.

To Select the Current Subject’s Report

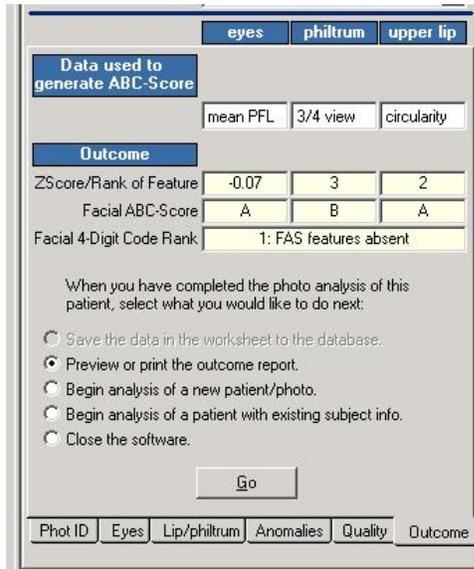
To preview the Report of the subject whose data is currently showing in the Worksheet, select *Print/Preview report for current subject*.

To Select Previous Subjects’ Reports

To preview the Report(s) of previous subjects whose data was saved to the Facial Software Database, select *Print/Preview report(s) for selected subject(s)*.

Printing the Outcome Report

Method 1



There are two methods to print the Outcome Report

1. Select the Outcome Tab and select “Preview or Print outcome report”

A copy of the current subject’s Outcome Report will appear.

Click on the Print button in the top menu bar.

Method 2



Printing the current subject’s Report



Printing a previous subject’s saved Report

2. Select Report from the top menu bar to open the “Print/Preview Options” window.

To Print the Current Subject’s Report

To print the Report of the subject whose data is currently showing in the Worksheet, select *Print/Preview report for current subject*.

Then click on the Print button.

To Print Previous Subjects’ Reports

To preview the Report(s) of previous subjects whose data was saved to the Facial Software Database, select *Print/Preview report(s) for selected subject(s)*.

Then click on the Print button.

FAS Facial Photographic Analysis Report

IDENTIFICATION			
Name	John	T	Doe
	First	Middle	Last
Subject I.D.	None		
Source of Photo	Clinic		
Gender	Male		
Race	Caucasian/Caucasian		
Birth Date	1/1/1990		

PHOTO ASSESSMENT			
Normal PFL Chart:	<u>Scandinavian (Stromland '99)</u>	Lip-Philtrum Guide:	<u>Caucasian</u>
Normal ICD Chart:	<u>Caucasian (Hall '89)</u>	Frontal	¾ View
			Lateral
File Name	Demo Frontal	Demo 3/4	Demo Lateral
Date of Photo	6/22/1998	6/22/1998	6/22/1998
Age (yrs) in photo	8.47	8.47	8.47
Date of Photo Assessment	6/22/1998	6/22/1998	6/22/1998
Photo Assessor	Astley	Astley	Astley
Length of Real Internal Measure of Scale(sticker) placed on forehead (mm)			19.05
Length of Internal Measure of Scale in Frontal Photo (pixels)			155.2
Left Palpebral Fissure Length:	In photo (pixels) <u>208.5</u>	True Length (mm) <u>28.2</u>	Z-score <u>1.04</u>
Right Palpebral Fissure Length:	In photo (pixels) <u>205.5</u>	True Length (mm) <u>27.7</u>	Z-score <u>0.67</u>
Mean Palpebral Fissure Length:	In photo (pixels) <u>207.0</u>	True Length (mm) <u>28.0</u>	Z-score <u>0.86</u>
Inner Canthal Distance (ICD):	In photo (pixels) <u>200.0</u>	True Distance (mm) <u>24.5</u>	Z-score <u>-2.22</u>
Flat Philtrum (5-point rank):		In Frontal Photo <u>3</u>	In ¾ Photo <u>3</u>
Thin Upper Lip:	Circularity (perimeter ² /area) <u>44.2</u>	5-Point rank (Circ) <u>2</u>	5-Point rank (Scale) <u>2</u>
clown eyebrows <input type="checkbox"/> ptosis <input type="checkbox"/> strabismus <input type="checkbox"/> epicanthal folds <input checked="" type="checkbox"/>			
flat midface <input type="checkbox"/> protruding ears <input type="checkbox"/> flat nasal bridge <input type="checkbox"/> hypertelorism <input type="checkbox"/>			
Other anomalies present: <u>hypotelorism</u>			
Comments:			
Other syndromes present: <u>None reported</u>			

PHOTO QUALITY			
	Frontal	¾ View	Lateral
Side showing		Right	Left
Head rotation (5-point rank/degrees) to subject's Right (+) or Left (-)	<u>0°</u>	<u>0</u>	<u>0</u>
Head tilt (5-point rank) toward subject's Right (+) or Left (-) shoulder			<u>0</u>
Head tip (degrees) Up (+) or Down (-) from Frankfort Horizontal Plane	<u>0°</u>		
Exposure (3-point rank)	<u>1 (good)</u>	<u>1 (good)</u>	<u>1 (good)</u>
Focus (3-point rank)	<u>1 (good)</u>	<u>1 (good)</u>	<u>1 (good)</u>
Facial Expression (3-point rank)			
Reliability of ABC-Score for palpebral fissure length (5-point rank)	<u>1 (very good)</u>		
Reliability of ABC-Score for philtrum (5-point rank)	<u>1 (very good)</u>	<u>1 (very good)</u>	
Reliability of ABC-Score for upper lip (5-point rank)	<u>1 (very good)</u>		

OUTCOME			
ABC-Score	A	B	A
	PFL	Philtrum	Lip
Data Used	mean	¾ view	circularity
4-Digit Diagnostic Code for Face	<u>1: FAS features absent</u>		



Demo Frontal Demo 3/4 Demo Lateral

University of Washington FAS DPN FAS Facial Photographic Analysis Software © 2016

Report for Practice Case John Doe

Database Management

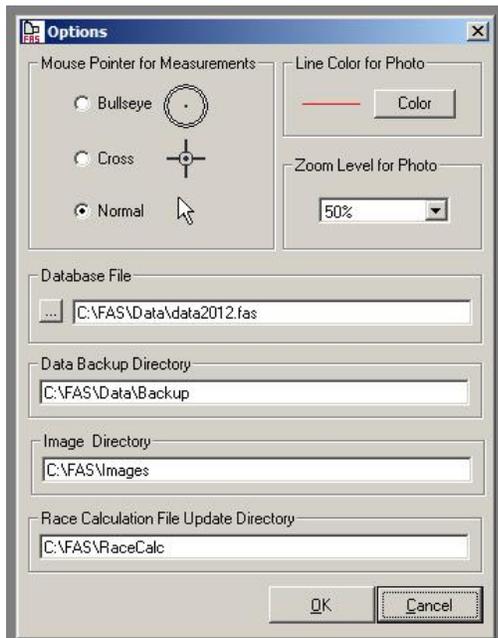


Fig. 7. Options box opened from the Tools tab on the top menu bar.

To Use: Select Data/Logs from the top menu bar and select Database Management from the drop-down menu.

The following database management tools are provided.

1. Database File

Allows you to navigate to the **.fas** database you want to store your photo analysis data in.

2. Backup Data

The Backup Data option makes a backup file of the database currently displayed in the 'Database File' window in the Options box (Fig. 7). The backup file will be named with the date you backed it up followed by **data.bak**. For example, if you pushed the backup button on July 16, 2012, the file would be named **(7-16-2012data.bak)**. This backup file will be stored in the directory displayed/selected in the 'Data Backup Directory' window in the Options box (Fig. 7). If your database file becomes corrupted, you can restore it from any backup files you made.

3. Restore Data

If something happens to the database file you are currently working with [(e.g., the file designated in the Database File window in the Options box (Fig. 7))], the Restore Data option lets you choose from any backup files you may have made and **overwrites** the database file you are currently working with [e.g., the file designated in the Database File window in the Options box (Fig. 7)], with the restored backup file. The restored database file will only contain data stored before the backup was made. If you have not made any backup files, you will not be able to use this function.

4. Compact Data

The Compact Data option packs data more efficiently in the database file, resulting in a smaller file size. The FAS Facial Analysis software does this for you automatically every time you open the program.

5. Import New Racial Calculations

In future versions, we anticipate providing you with additional racial norms for PFL and inner canthal distance. These new norms would be imported into the software via this route. Please see more about importing new racial calculations below.

6. Set Password

The software program may be password protected with this feature.

View Logs

To Use: Select Data/Logs from the top menu bar and select View Logs from the drop-down menu.

The following logs document all activity regarding Errors, Back up and Restoration.

1. Error Log
2. Back up Log
3. Restore Log

Importing New Racial Calculations for PFL Z-scores

FAS Version 1.0 provided palpebral fissure length (PFL) z-score formulas for Caucasians and African Americans. FAS Version 2.0 software provides PFL z-score formulas for Caucasians, African Americans, Canadians, and Scandinavians. It is important to understand that these formulas are stored IN THE SAME DATABASE as your photo analysis data. The Caucasian and African American formulas are stored in the **data.fas** database for Version 1.0. The Caucasian, African American, Canadian, and Scandinavian formulas are stored in the **data2012.fas** database for Version 2. If you open an older database (e.g., **data.fas**) created by Version 1.0 into the new Version 2 software, the new PFL formulas to compute Canadian and Scandinavian PFL z-scores will be missing. You will discover this when you go to the Eye Tab in the software Worksheet and click on the drop-down menu for “Select Normal PFL Chart”. Only Caucasian and African American PFL Charts will be available.

But it is simple to import the new Canadian and Scandinavian PFL z-score formulas into your older Version 1.0 **data.fas** database.

Follow these instructions:

1. It is assumed that the FAS Facial Software Version 2 is open and the Database File selected in the Options window (Fig 3 above) is pointing to an older **data.fas** database that does not currently have the Canadian and Scandinavian PFL formulas in it.
2. Click on the menu item: Data/Logs → Database Management → Import New Racial Calculations.
3. On the **Select File for Update** dialog box, select the **Canadian Male.rcf** file located in C:\FAS\RaceCalc\ and click the **Open** button. (See Fig. 8)
4. A message box will appear showing “New racial calculations have been successfully imported”. Click the **OK** button.
5. Repeat step 3, but this time select the **Canadian Female.rcf** file and click the Open Button.
6. A message box will appear again confirming the upload. Click the **OK** button. (See Fig. 8)
7. Click on the menu item: Data/Logs → Database Management → Import New Racial Calculations.
8. On the **Select File for Update** dialog box, select the **Scandinavian Male.rcf** file located in C:\FAS\RaceCalc\ and click the **Open** button. (See Fig. 8)
9. A message box will appear showing “New racial calculations have been successfully imported”. Click the **OK** button.
10. Repeat step 3, but this time select the **Scandinavian Female.rcf** file and click the Open Button.
11. A message box will appear again confirming the upload. Click the **OK** button (See Fig. 8).
12. Re Start the FAS Facial Software.
13. Go to the Eye Tab in the software Worksheet and click on the drop-down menu for “Select Normal PFL Chart”. You should now see all four PFL options available.
14. See our website (fasdpn.org) for guidance on which PFL charts to use.

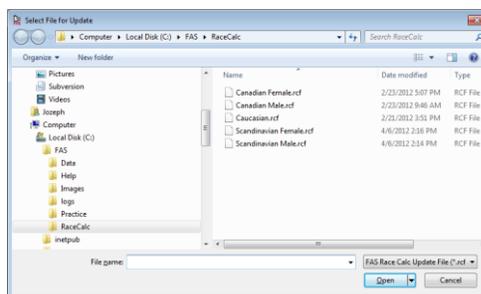


Fig. 8.

DICTIONARY

Anomaly

A physical feature that is present in less than 2% of an age and race appropriate sample of the population

Circularity

A quantitative measure ($\text{perimeter}^2/\text{area}$) used to objectively measure upper lip thinness. The thinner the upper lip, the greater the circularity. See the Lip Circularity Table on the backside of the Lip-Philtrum Guides.

Clown eyebrows

Eyebrows that arch upward at the lateral margins. The eyebrow typically follows the superior border of the bony orbital rim. Clown eyebrows are often secondary to microcephaly. See the FAS Face / Other Anomaly Pictorial Guide.

Endocanthion

The facial landmark demarcating the inner corner of the eye fissure where the eyelids meet. See the Landmark / Rotation Pictorial Guide.

Epicanthal fold: Lateral extension of skin of the nasal bridge over the endocanthion landmark. May be unilateral or bilateral. May be indigenous to some races. More common in very young children of all races. See the Landmark / Rotation Pictorial Guide.

Exocanthion

The facial landmark demarcating the outer corner of the eye fissure where the eyelids meet. See the Landmark / Rotation Pictorial Guide.

External auditory canal

The external opening of the ear canal. This is one of two landmarks that demarcate the Frankfort Horizontal plane when viewing the lateral facial photograph. See the Landmark/Rotation Pictorial Guide.

Flat (hypoplastic) midface

Under-development of the maxilla relative to the nasal process.

Flat nasal bridge

The bridge of the nose between the eyes is depressed (flattened). May be indigenous to some races and is more common in very young children of all races. See the FAS Face / Other Anomaly Pictorial Guide.

Frankfort horizontal plane

A plane demarcated by a line drawn from the external auditory canal to the lowest border of the bony orbital rim (orbitale). This plane is used in anthropometry to standardize the positioning of the head. For the purposes of measuring FAS facial features, the camera lens should be placed in the patient's frankfort horizontal plane. See the Landmarks/Rotation Pictorial Guide.

Hypertelorism

Ocular hypertelorism is an abnormal increased distance between the centers of the pupils. This term is also often used to denote an abnormal increased distance between the right and left endocanthion landmarks (or telecanthus).

Hypotelorism

Ocular hypotelorism is an abnormal decreased distance between the centers of the pupils. This term is also often used to denote an abnormal decreased distance between the right and left endocanthion landmarks.

Inner Canthal Distance

The distance between the eyes from the right endocanthion to the left endocanthion. See the Landmark/Rotation Pictorial Guide.

Internal Measure of Scale

The paper sticker (typically $\frac{1}{2}$ to $\frac{3}{4}$ inch) placed on the patient's forehead to serve as a ruler or internal measure of scale in the photograph. This allows the true PFL and inner canthal distances to be computed. See the Landmark/Rotation Pictorial Guide.

Orbitale

The lowest point on the bony orbital rim. This is one of two landmarks that demarcate the Frankfort Horizontal plane. See the Landmark/Rotation Pictorial Guide.

Overlay

A term used in this software program that refers to the lines that are temporarily drawn on the photograph when distance or circularity measures are being taken. These overlays can be removed from the photograph by clicking on Image/Clear Overlays in the Menu bar.

Palpebral fissure length (PFL)

A measure of the size of the eye. The distance from the exocanthion to the endocanthion landmarks. See the Landmark/Rotation Pictorial Guide.

Phenotype

Physical appearance.

Philtrum

The vertical groove between the nose and upper lip. See the Landmarks/Rotation Pictorial Guide.

Pixels

A unit of measure used in computerized image analysis. A pixel is one dot of light on the computer monitor.

Ptosis

Drooping of upper eyelid. Generally caused by a weakness in the levator palpebrae superioris muscle. See the FAS Face / Other Anomaly Pictorial Guide.

Thin upper lip (or thin vermilion border)

When measuring the thinness of the upper lip, the part of the upper lip that is being referred to is the red or vermilion portion of the upper lip. See the Landmarks/Rotation Pictorial Guide.

Tragus

A small extension of tissue in front of the external auditory canal. This is one of two landmarks that demarcate the Frankfort Horizontal plane when viewing the frontal facial photograph. See the Landmark/Rotation Pictorial Guide.

Z-score

The z-score reflects how many standard deviations above or below the population mean the patient's PFL is, based on the patient's age and gender. The z-score is defined as the patient's PFL minus the mean PFL for the normal population divided by the standard deviation of the mean PFL for the normal population.

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fasdpn.org

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