

# The Application of 3D Images for **Quantitative** Determination of **Zygoma** in an **Asian** Population

Shih-Hsuan Mao, Yu-Hsuan Hsieh, Chih-Hao Chen,  
Chien-Tzung Chen

*Department of Plastic and Reconstructive Surgery, Chang Gung Memorial  
Hospital at Linkou, Taiwan*

*Nothing to Disclose*

# introduction

## **commonly fracture of zygoma**

zygomatic complex is the most prominent and most commonly fracture in midface

## **postoperative asymmetry**

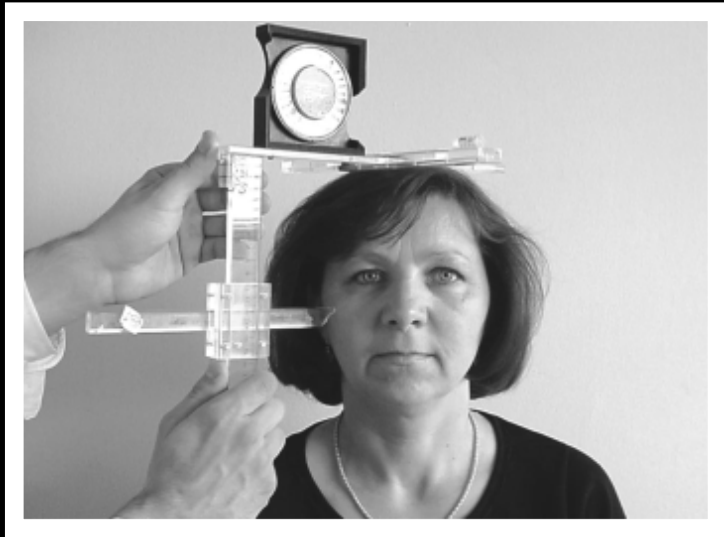
asymmetry and poor aesthetic outcomes in 10% of patients

## **insufficient if realign bones only**

both skeletal and soft tissue affects outcomes

## **tools for more accuracy**

is there anthropometric methods for quantitative evaluation?



*Czerwinski, 2005*

## Quantitative topographical evaluation

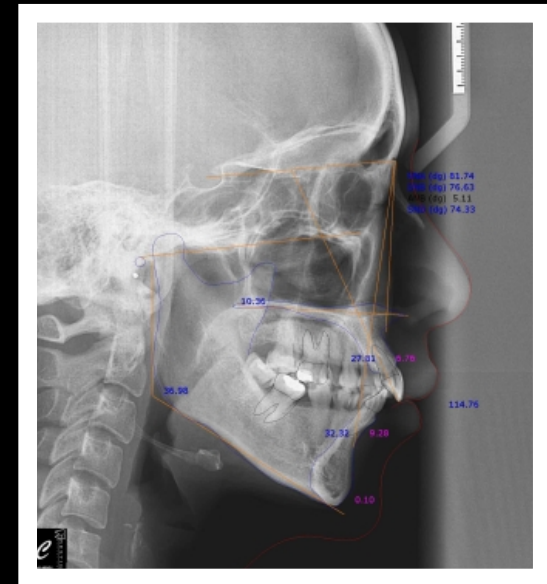
It is accurate in soft tissue, but

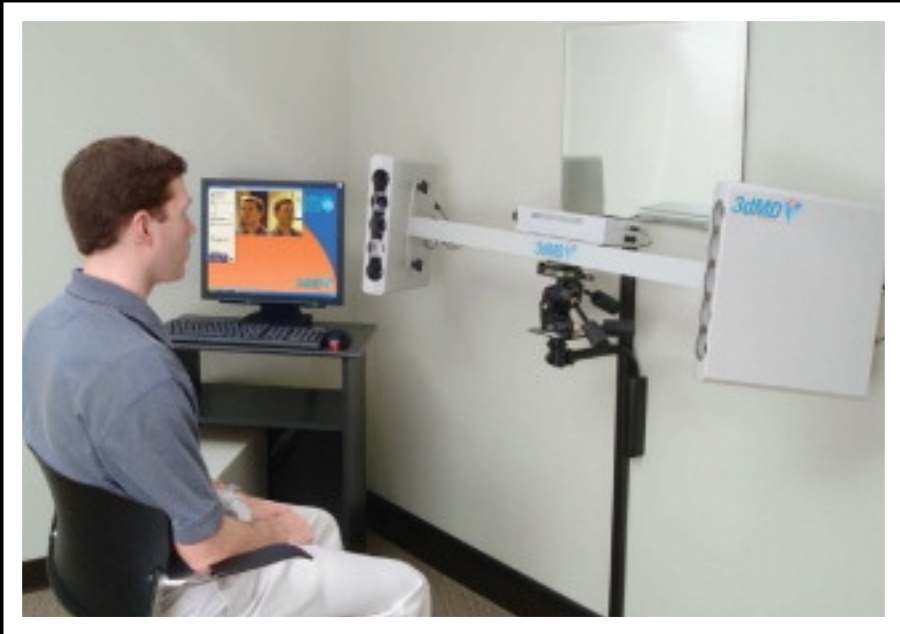
- **time consuming**
- **inconvenient to repeat**
- **poor evaluation of bone**

## Cephalometry

It is convenient and fast, but

- **overlapped structure**
- **measurement errors from positioning**





*Lane, 2008*

## 3D digital photogrammetry system

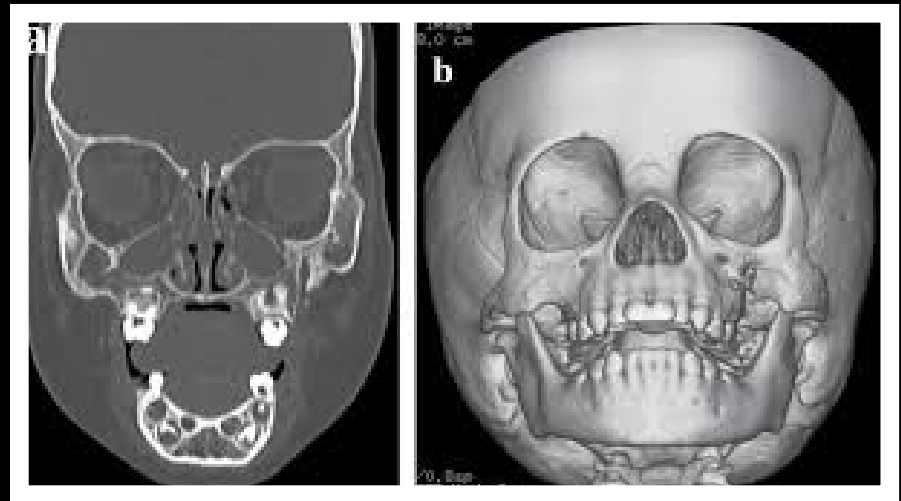
It is accurate in soft tissue, but

- image distortion
- poor evaluation of bone
- costly

## Traditional CT

It is accurate in bone tissue, but

- measurement errors from positioning



## insufficient tools

none of the methods is able to measure both soft and hard tissues simultaneously.

## CT 3D images

- Increase in resolution of CT images
- Widely applications of 3D images

## computer-assisted system

- Amira®

## **idealization of anthropometry**

- fast and accurate
- regardless of position at image acquisition
- measure both bone and soft tissues simultaneously

## **3D CT images processed by Amira®**

- determine the reference points and distance values
- examine the accuracy and repeatability
- determine symmetry from bilateral values

# materials & methods

20 Taiwanese adults randomly selected  
underwent craniofacial CT

- 10 male
- 10 female

## Inclusion criteria

- bilateral zygoma intact
- no zygomatic injuries
- trauma surveys negative

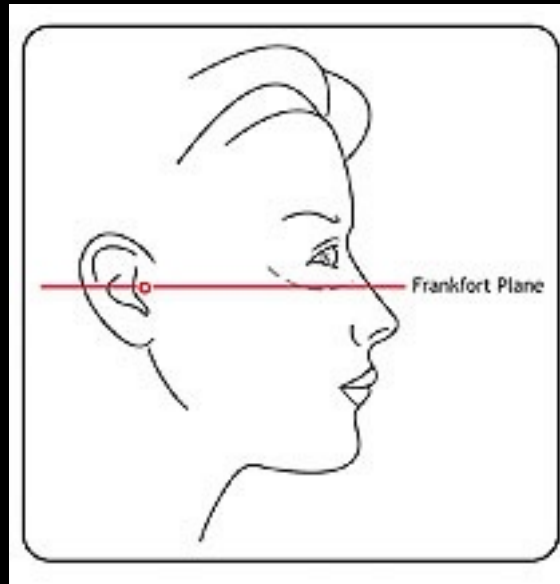
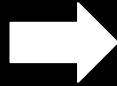
## Exclusion criteria

- congenital anomalies of face
- injuries of zygoma
- prior surgical history

# protocols



CT Acquisition at initial presentation (ER)

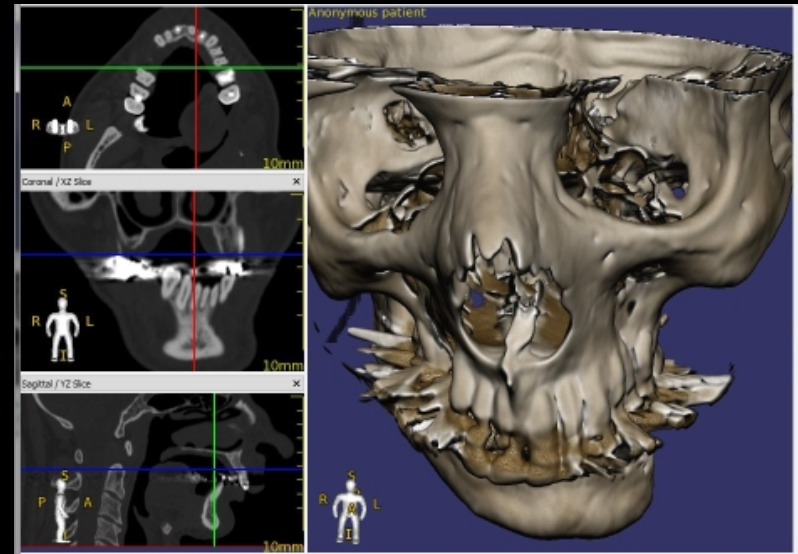
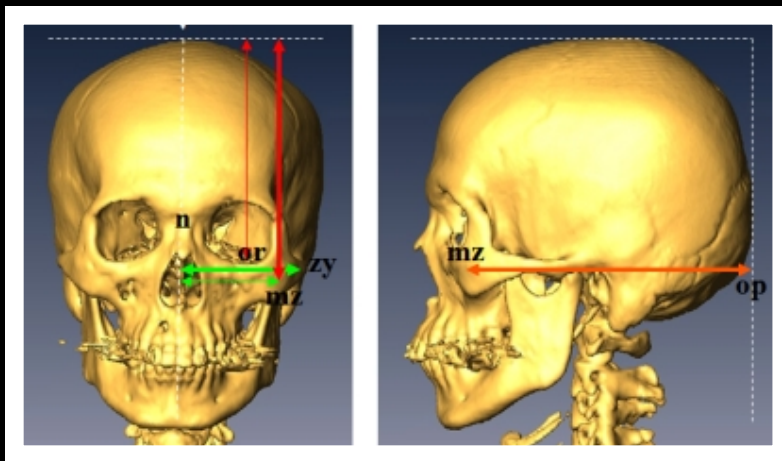


Frankfort horizontal position by Amira®



CT data (DICOM) to STL files by Amira®

## Measurement of references distances

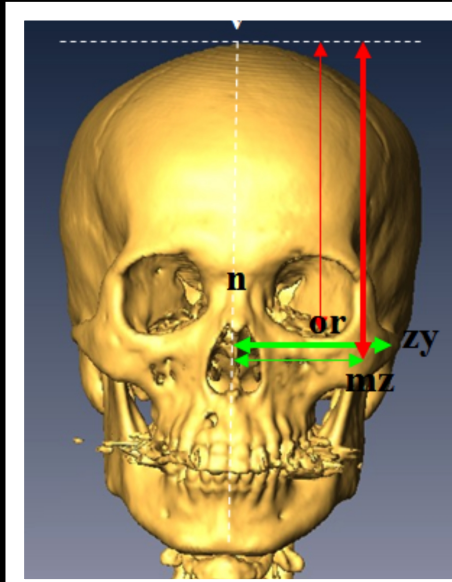




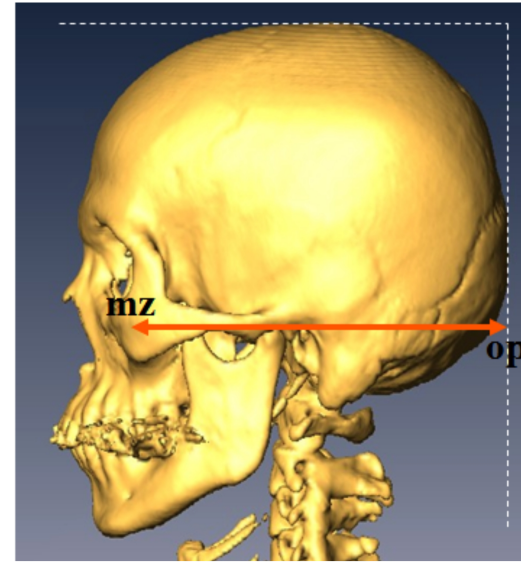
# reference points and axis

Donald, 1990; Czerwinski, 2005

**Nasion (n)**  
point in midline of  
nasal root and  
nasofrontal suture



**Orbitale (or)**  
lowest point on  
inferior orbital rim



**Zygion (zy)**  
most lateral point on  
zygomatic arch

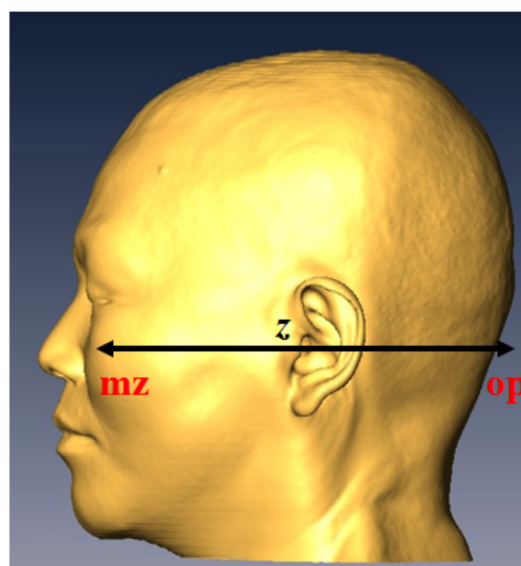
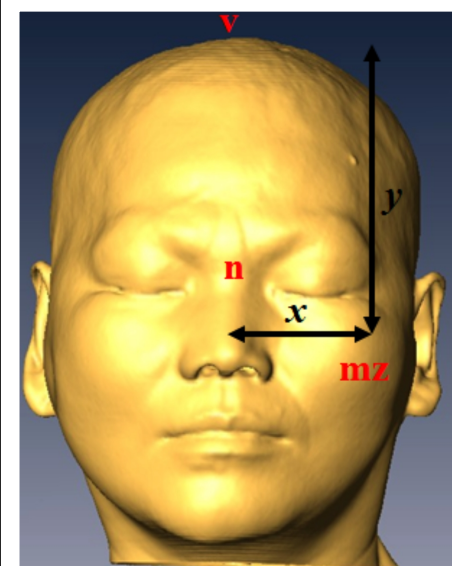
**Maxillozygion  
(mz)**

most prominent  
point on frontal  
aspect of face,  
below bony orbit

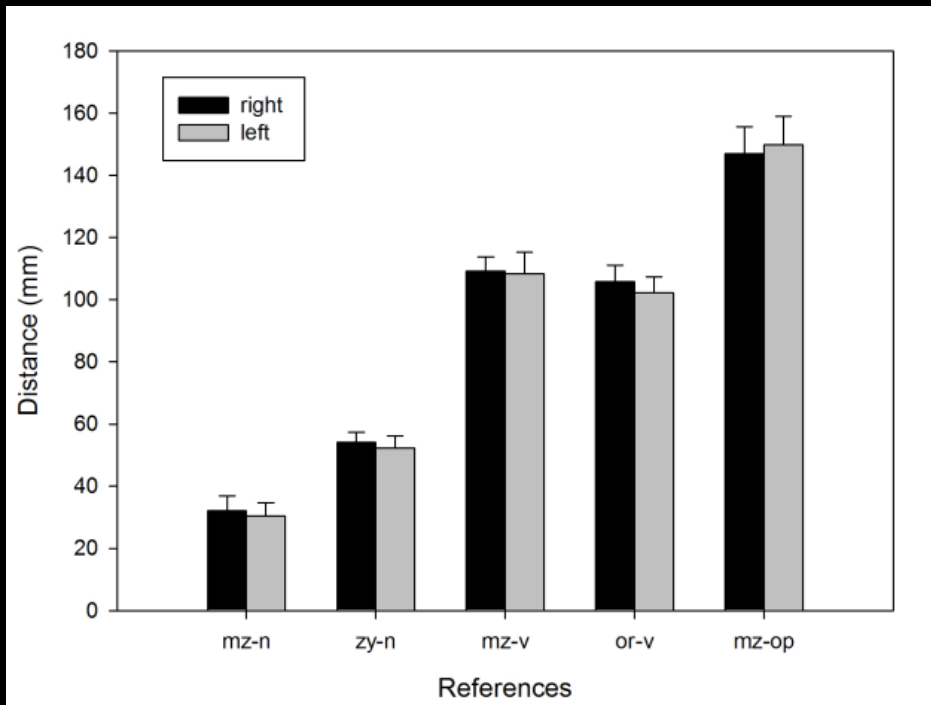
**Opisthocranio  
n (op)**

most posterior point  
of head at FH  
position

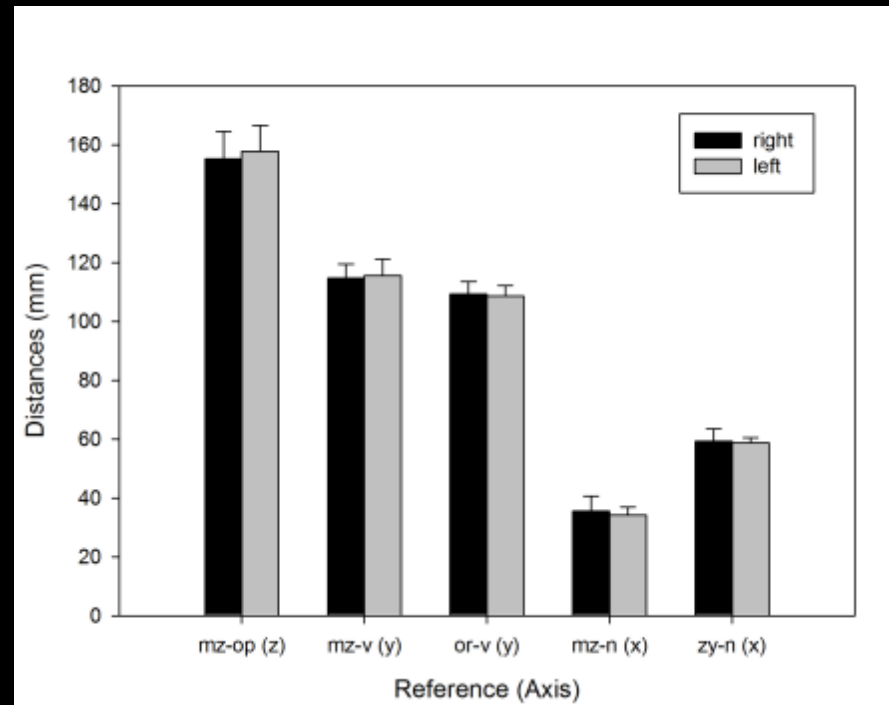
**Vertex (v)**  
highest point of  
head at FH  
position



# results of measurements



Bone tissues



Soft Tissues

no significant difference bilaterally ( $P < 0.05$ )

# results of measurements

|             | <b>inter-subject variability (SD1)</b> | <b>inter-measurement variability (SD2)</b> |
|-------------|--|--|
| Bone        | 3.1-9.2 mm                             | 0.7-1.6 mm                                 |
| Soft Tissue | 1.8-9.3 mm                             | 0.1-1.8 mm                                 |

## inter-subject

- **relatively small compared to the mean**
- relatively constant position of zygoma in skull

## inter-measurement

- SD2 < 2 mm
- **clinical insignificant for repetitive errors**
- unable to detect in experience surgeons

# clinical significance

## Positioning

- mis-positioning leads to errors
- no adjustment required before CT images acquirement
- proper positioning by Amira<sup>®</sup>

## Symmetry

- no significant difference between both sides ( $P < 0.05$ )
- allowing comparison for establishing symmetry with unilateral lesion

# conclusion

## **3D facial CT with Amira®**

Time-saving, accurate, consistent

## **asymmetrical determination**

determining degree of asymmetry by quantitative comparison of ipsilateral side

## **measurement of skeletal and soft tissue**

both tissue can be assessed separately and accurately

## **tool for comparison**

accurately determine the surgical outcomes among different techniques on zygoma

# future works

## **restore symmetry**

mirroring the contralateral side of zygomatic complex  
assisting symmetry intraoperatively

## **reference database**

more data as a reference database for quantitative  
evaluation

## **dynamic relation**

evaluate the dynamic state between skeletal and soft  
tissues for better post-operative estimation

## **navigation**

guide of intraoperative navigation