

# Aging Skeletal Remains: An Investigative Lab Experience in Human Anatomy

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**Abstract:** This session will present a lab technique that can be incorporated into an anatomy lab course that is traditionally non-investigative. The featured technique employs the endochondral (sternal) end of the human rib for age determination of skeletal remains. This research component enhances student learning during lab experiences. The students, working in groups, are given techniques to determine age. This session will include samples of human ribs and a demonstration of how to determine age based upon the techniques discussed and shared.

## Introduction

An investigative technique in a typical anatomy lab can enhance student learning. This lab technique can extend morphological identification into student-centered research activities. For example, age-related metamorphoses are observable by gross examination of the endochondral extremity of the rib. These changes, previously characterized (Iskan *et al.*, 1984a, b), can be used in the student lab. This lab experience can further strengthen research skills, including record keeping and those associated with reading and using scientific literature. It can also provide a cost effective research opportunity to small schools that use cadavers.

## Student Outline

### Specimen Preparation: Defleshing

Fourth right ribs were harvested from cadaveric specimens. Following dissection, the specimens were then immersed in water for a few weeks, and then placed in gently boiling water for approximately three to four hours. The excess flesh and connective tissue were then physically stripped from the bone. The remaining costal cartilage was carefully removed from the endochondral end with a fine-toothed forceps.

### Specimen Analysis

Iskan *et al.* (1984a, b) developed two systems to determine age based on metamorphoses of the endochondral extremity of the rib. They used a controlled sample of individuals of known sex, age, and race. They established separate standards for males and females due to sexual differences in hormonal

production and pronounced sexual dimorphism in the skeleton. The defleshed fourth right ribs were carefully examined according to Iscan *et al.*'s methods.

### *Component Method*

The component method consists of examining three factors or components - pit depth, pit shape, and rim and wall configurations. The age-related morphological changes are most noticeable in these areas.

The first component, Component I, is depth of the pit created by the walls of the rib. The maximum pit depth is measured with a depth caliper calibrated to 0.1 mm. Maximum pit depth is the distance between the base of the pit and the greatest adjacent anterior or posterior wall. Care must be given when manipulating a depth caliper, as it must be perpendicular to the base of the pit to ensure accurate measurements.

Component II is pit shape, which is initially a slight, amorphous indentation. Within 1 year of initial appearance, the pit develops into a V-shaped structure, formed by the anterior and posterior walls of the rib. Age-related changes in pit shape include a transformation of the V to a continuously widening U, due to a progressive thinning of the pit wall.

The third component, Component III, is rim and wall configuration. Initially the pit rim is smooth, with regular borders. The rim rapidly assumes a scalloped but still fairly regular shape. With advancing age, the rim and walls become increasingly irregular, thin, and sharp.

Each of the components consists of different stages based on the measurements and observations of the pit. Numerical designations (scores) correspond to each stage of each component. The three component scores are combined (component I + component II + component III) and compared to established guidelines (Iscan *et al.*, 1984a).

### *Phase Method*

Iscan *et al.* (1984b) revised his component analysis method due to its complexity, unwieldiness, and inconvenience for rapid estimation of age at a crime scene or in the field. Iscan *et al.*'s revised method, the phase method, distributed specimens into eight phases based on changes noted in the form, shape, texture, and overall quality of the sternal rib. Essentially, the components, with the exclusion of Component I or pit depth, were combined and an examination of the bone appearance was added. Upon analysis, the bone was assigned an age estimation phase (Iscan *et al.*, 1984a, b).

## **Instructor's Notes**

### **Level of Difficulty**

One option for this lab would be to provide students with the techniques and resources or assign a search for age determination by utilizing the rib. Another way to alter the level of difficulty of this lab would be to provide your student with a prepared rib or have the students dissect and prepare the rib for analysis.

### **Additional/Alternative Experiments**

- The extent of costochondral ossification can also be used for age determination (McCormick, 1980) or sex determination (McCormick and Stewart, 1983).

- Other gross morphological measures for sex determination include maximum superior-inferior height (S-I), maximum anterior-posterior breadth (A-P), and maximum pit depth (Iscan, 1985).

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