Assessment of Pubertal Growth Spurt in Egyptian Adolescent Girls Using Middle Phalanx of the Middle Finger (MP3) and its Correlation with Bone Radiodensitometry Analysis (Alexandria Government) (Cross sectional study)

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DEDICATION

To the soul of my father
who taught me the meaning of life.

To my mother
I would have reached nothing without your supplicate, love and support.

To my wife
Thanks for always being there for me, it couldn’t be done without you.

To my Daughters
You completed my life.

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LIST OF ABBREVIATIONS

BMC: Bone Mineral Content

BMD: Bone Mineral Density

CVM: Cervical vertebrae maturation

DXA: Dual energy x-ray absorptiometry

HWM: Hand-wrist maturation

IGF: Insulin like growth factor

IOPA: Intraoral periapical film

MP3: Middle Phalanx of Middle Finger

MPM: Middle phalanx maturation

MPS: Middle phalanx stages

PGS: Pubertal growth spurt

PHV: Peak height velocity

PMdV: Peak mandibular growth velocity

RA: Radiographic absorptiometry

SM: Skeletal maturity

SMI: Skeletal maturity indicator

INTRODUCTION

Growth is a biological process that occur throughout life. The growth events is of primary concern in many practical fields in orthodontics, in which clinical decision regarding the use of orthopedic treatment depends primarily on the optimal timing of the active growth period.

The physiological maturity can not be accurately assessed by chronological age alone, because of the great individual variations in timing, duration, and velocity of growth.

Skeletal maturation indicators provide us with the most reliable maturity indicators in comparison to the chronological and dental age in growing child.[1, 2]

Several skeletal maturity indicators have been used in orthodontic field. The hand wrist and cervical vertebrae, have been used as a reliable methods for the assessment of skeletal maturity, both methods have the disadvantages of high radiation exposure, and requiring elaborate special equipment.

Middle phalanx of middle finger (MP3) as described by **Hagg and Taranger**[2], is considered as the less invasive method for the assessment of skeletal maturity, with the same reliability as hand wrist or cervical vertebrae maturation indicators. In addition to using the new technology of digital dental radiography with dental X-ray which makes the method more simple with ease of manipulation and archiving.

Regarding the bone density, several studies reported that bone mineral density (BMD) increased progressively with age, with a rapid increase in bone mineral density (BMD) and bone mineral content (BMC) observed at earlier ages in girls.

Several techniques for bone mineral density (BMD) assessment are currently available. Based on intra-oral radiographs, panoramic radiographs, cone beam and micro-computed tomography, dual energy X-ray absorptiometry (DXA), magnetic resonance imaging and quantitative ultrasound (QUS) [3].

A dual Energy X-ray Absorptiometry (DXA) is considered as the method of choice because of its accuracy and relatively low radiation exposure, through scanning different bones of the human body, which could be a major determinant of bone health, and might be used for detection of certain bone conditions and diseases as osteoporosis. [3]

Intra-oral radiographs fulfill the requirements of clinically applicable, patient-friendly, widespread, easy tool for bone density evaluation, which is used by implantologists and oral surgeon to assess local bone status before and after implant placement.

As the development of digital radiography increased in recent years, several accurate and reliable computer softwares have been developed to be used for radiodensitometry assessment.[4]

Variations in growth pattern and skeletal maturation exist among different ethnic groups and genders[5, 6] . This study was aimed to assess the pubertal growth spurt among Egyptian adolescent girls using middle phalanx of middle finger (MP3), as a simple and available skeletal maturity indicator. Additionally it was aimed to detect any changes in bone radiodensity along with the process of maturation, this inturn might bring a useful tool to be utilized as an additional maturity indicator.

REVIEW OF LITERATURE

I. Importance of craniofacial growth and maturation

II. Maturity indicators

A- Chronological age

B- Physiological maturity indicators

1. Somatic maturity
2. Sexual maturity
3. Dental maturity
4. Biochemical maturity
5. Skeletal maturity

a. Hand-wrist maturation (HWM)
b. Cervical vertebrae maturation (CVM)
c. Middle phalanges of middle finger maturation (MP3)

III. Bone radiodensity

Review of Literature

I. Importance of craniofacial growth and growth spurt

Growth is a general term implying something that changes in magnitude, while development is the maturational process of differentiation at the cellular and tissue level.

The growth rate of human body varies throughout life, with the highest rate occurs during fetal period and continues immediately after birth, then falls rapidly until around 6 years of age, to give a period of relatively steady increase in height and weight. When puberty begins, a rapid increase accompanies sexual development and progress towards maturity (**Houston, 1980)**[1]**.**

Nanda (1955)[7] found that growth of the face followed a similar curve to that of general skeletal growth. However, there was significant individual variation in growth patterns, and some individuals, particularly females, demonstrated a juvenile spurt in jaw growth 1-2 years before the pubertal growth spurt.

Ochoa and Nanda (2004)[8] longitudinally assessed the growth pattern of the maxilla and mandible using serial lateral cephalometric radiographs of twenty eight untreated subject (15 female and 13 males) followed from age 6 to 20 years. They noted that a larger facial growth increments occurred at a younger age in girls than boys. The male development period usually lasts 2 years longer than that for females and provided relatively more growth. In males this had the effect of straightening the facial profile as the chin became more prominent, while female profiles remained convex due to less incremental growth and duration of growth of the mandible.

Soegiharto et al. (2008)[5] stated that, variation exist in the degree of growth and maturation among children of the same chronological age, also between different ethnic groups and genders.

Several factors could affect the growth and maturation of individuals, these factors might be environmental, hormonal and genetic factors, influencing human growth and development and the onset of puberty **(Wei and Gregory, 2009)**[9]**.**