PRIYADARSHINI DENTAL COLLEGE

BASICS OF CEPHALOMETRY AND NATURAL HEAD POSITION

CONTENTS

Introduction

The measurement of head of a living subject from the bony landmarks located by palpation or pressing through the supra-adjacent tissue is called cephalometry.

The measurement of the head from the shadows of bony and soft tissue landmarks on the radiographic image is known as roentgenographic cephalometry.
(krogman & sassouni 1957)

Why we need…???

Angle's classification on malocclusion

Assumption that the underlying skeletal jaw relationship would be normal

Extraction or mutilated dentition…..

Incisor inclination …..

In growth analysis by taking two or more cephalograms at different time intervals and comparing them.
In treatment analysis by evaluating alterations during and after therapy.
The beginning….
W.A Price in 1900, 5 years after the discovery of the x rays used radiography as the diagnostic aid.
The method was later derived in 1931(after extensive anthropologic craniometric studies and use of Broadbent-Bolton cephalometer/cephalostat).

In 1946, Dr. Charles Tweed developed Tweeds diagnostic triangle. First true classic full scale cephalometric analysis developed by William B. Downs in 1948.
In 1953, Dr. C.C. Steiner presented his famous Steiner's analysis. Riedel in 1952 developed SNA and SNB angle. Sassouni (1995) described total archial analysis.

Rickets (1960) give dynamic analysis to study morphology of a patient at different stages of development or treatment.
Jacobson's 'Wits' appraisal (1975) was used for assessing horizontal disharmony of the jaw.
For surgical correction quadrilateral analysis Dipaolo (1970) and an analysis by McNamara (1984) developed.

The standardization allowed the precise measurement and comparison of oral and craniofacial structures either directly or by tracings.
Along with lateral ceph the PA (posteroanterior) cephalograph provides additional radiographic information mediolaterally which is useful for presurgical and asymmetric growth evaluvation.
Cephalometric unit
X ray source
Adjustable cephalostat
Film cassette with radiographic intensifing screens
Film cassette holder
Basic units…..
In the past, radiographic cephalometric units with sophisticated and expensive tube heads were used to obtain optimal cephalometric radiographs.
The use of such tube heads which could operate at level of 100mA and beyond are necessary to keep the exposure low and artifacts to a minimum.

The use of such milliamperage settings was capable of keeping the exposure time well below 0.5 seconds but this produced extremely high temperatures at the tubehead's anode focal spot during imaging.
To prevent this the use of rotating anodes comes into effect. Many such units are used today.
These can also produce linear tomographs of TMJ.

Many practitioners are using panoramic units with cephalometric capabilities commonly called *pan/ceph units.*
The current pan/ceph units automatically align themselves (including selection of appropriate beam collimator) for panoramic, lateral or PA modes.
Some units also have soft tissue shields located within or in proximity to the tubehead

Also available are cephalometric adaptors that utilize the conventional tubeheads more commonly used in intraoral radiography.
In one configuration the conventional tubehead is permenantly mounted to a vertical transversable column that also connected to cephalostat /film holder and can be moved up or down for patient height adjustment.

Some units consist of permenantly mounting conventional tubeheads and separate cephalostat with cassette holder to a wall in fixed alignment.
A motorized chair is the used to raise or lower the patient into the proper position relative to the x ray beam and cephalostat.
ADVANCED UNITS
OP1000
It's a semi automatic unit..
It contains the different setup voltages for child juvenile adult heavy adult.

110 VAC	63kV/6,4mA	63kV/ 10mA	63kV/ 12mA	70kV/ 12mA
230 VAC	63kV/ 6,4mA	63kV/ 10mA	63kV/12mA	66kV/ 16mA

It contains positioning lights which varies with prognathism..

It can give even the segmental archs sections and maxillary sinus, tmj lateral projections, and tmj posteroanterior projections also.
Kodak8000
It's a mobile or wall mount unit.
It has digital sensor locators.
It gives a detailed options for choosing which area to be taken for the x ray.
It also gives options for choosing the age and built of the patient.

ORTHOPANTAMOGRAPH OP30
Sharp and detailed images are enabled by powerfull tubehead and wide range of exposure

settings that fit every patient size. A special V-shaped radiation beam is essential to overcome anatomical differences between the patients.
Just 2 selections need to be made from the
control panel:

Choose the imaging program
Select patient size

Patient positioning
Intuitive 5-point patient positioning system holds the patient still during the imaging procedure to reduce movement artifacts. Three laser positioning lights make positioning accurate. The sharp layer is easily adjustable for every patient.
V-shaped collimation optimizes image quality
Orthopantamograph OP 300 it also gives 3Dimages,CBCT etc along with basic cephametry.
X ray
The x-ray tube is a high vacuum tube that serve as a source of the x-rays. The three basic elements that generate the x-rays are a cathode, an anode, and the electrical power supply. The cathode is a tungsten filament surrounded by a molybdenum - focusing cup. The tungsten filament serves as a source of electrons.

The differential potential between the cathode and the anode accelerates the electron cloud, which forms electron beams. The beams arc directed by the focusing cup to strike a small target on the anode called the focal spot. Bombardment of this target by the electrons produces the x-ray beam.

Collimater
Beam collimators are 'beam direction' devices used in the X-ray tube housing, along with an arrangement of mirrors and lights, in such a way that the light and X-ray fields match each other. They are made of lead shutters which completely absorb the photons, and thus reduce patient dose as well as focus the radiation accordingly to the area of interest. They allow different projections of X-ray fields.

filters
Filters are metallic sheets that are used to absorb the low energy X-ray photons from the spectrum thereby reducing the patient dose.

The process is called filtration and is of two types

inherent filtration (tube and housing)
added filtration (aluminium and copper)
Total filtration = inherent + added filtration

cephalostat

The use of a cephalostat, also called a head-holder or cephalometer, is based on the same principle as that described by Broadbent. The patient's head is fixed by the two ear rods. The head which is centered in the cephalostat, is oriented with the Frankfort plane parallel to the floor and the midsagittal plane vertical and parallel to the cassette.

X RAY FILM

The basic component of x ray film is an emulsion of silver halide crystals suspended in a gelatin framework and a transparent blue tinted cellulose acetate that serves as a base.

When the silver halide crystals are exposed to the radiation they are converted into metallic silver deposited in the film there by producing a latent image. This is converted into permanent after the processing.

The amount of metallic silver deposited into the emulsion determines film density, whereas the grain size of the silver halide determine film sensitvity and definition.

INTENSIFYING SCREENS

These are used in pairs together with the film to reduce the patient exposure dose and increase image contrast by intensifing the photographic effect of x- radiation.

They consist of phosphorescent crystals such as calcium tungstate and barium lead suplhate coated onto a plastic support.

When the crystals are exposed to the x rays they emit florescent light that is recorded by the screen film.

Both film and screen are packed in light tight box called cassette.

Cassette is light tight to prevent the florescent light emitted by intensifying screens radiating in all directions before reaching the film as this would diminish the sharpness of the image…

GRIDS

Of all the beam emitted from the x ray tube only 10 % has the tissue penetrating power and remaining 90% gets absorbed by the irradiated tissue and emits as secondary or scattered radiation which will travel oblique to primary beam and cause fogging.

To prevent this the grid contains of radiopaque(lead) strips & radiolucent(plastic) strips arranged in alternate manner to prevent the scattered rays to pass through the them and reach the film..

Some grids slightly move during exposure to prevent the grid pattern on the radiograph this type of moving grid is called *potter-bucky grid.*

NATURAL HEAD POSITION

It's a standardized and reproducible orientation of the head in space when one is focusing on a distant point at eye level.

Attention was focused on finding a posterior landmark for a plane through the lowest part of orbits that would approximate a true horizontal extracranial plane.

Porion was selected as most suitable landmark.

Downs (1956) -illustrated the discrepancies between Cephalometric facial typing and photographic facial typing disappear when a correction is made for those persons in whom the "Frankfort plane" is not horizontal, but tilted up or down while the patient is looking at a point in the distance at eye level.

After considerable deliberation of the German Anthropological Society, they reached an agreement in 1884 called *Frankfort agreement* and started using FH plane as referral plane.

since intracranial landmarks are not stable points in the cranium their vertical relationship to each other is subjected to biological variation (eg: S-N, Po-Or). *Bjern& Thurow.*

Broca defined NHP in 1861 as "when a man is standing and when his visual axis is horizontal, his head is in the natural horizontal position". The simplest procedure to obtain head radiographs in the NHP is to instruct the patient to sit upright and look straight ahead to a point at eye level so that the head level is determined by the internal physiological mechanism.

Other devices such as fluid level device, inclinometer and the plumb line have been used to measure the head posture.

The procedure for obtaining the NHP in cephalometric radiography is particularly pertinent to obtain a reliable image of the head in so called PA or frontal projection.

Both Fränkel and Lundström et al supported this concept of NHP as a small range of positions oscillating around a mean posture. Thus, NHP is actually a dynamic concept.

NATURAL HEAD POSTURE

The head posture changes continuously throughout the functional activities.

Ortho Position

It is defined as "the momentary interim position when taking the first step forward from a standing to a moving or walking posture".

A long mirror is used for this procedure to include the different inclinations In the head.

In any case the terms NATURAL HEAD *POSITION* and HEAD *POSTURE* are not interchangable, one being a standardized procedure applied to all individuals for analysis of dentofacial morphology and the other an individually characteristic physiologic posture of the head to study the relation between posture and morphologic features.
Small mirror for NATURAL HEAD POSITION is used to force the subject look into their eyes.

Advantage of Natural Head Position
1.It provides the use of an extracranial reference line (true vertical or horizontal) for cephalometric analysis.

2.When Facial photograph and cephalometric tracing of patient are both taken in Natural Head Position, direct correlation can be made between real-life appearance and tracing

3.NHP should be the head position of preference for profile evaluation because it reflects the everyday true-life appearance of people. (Cooke 1986)

4.The natural head position of individuals is relatively constant over time (a standard deviation of 2.05°). (Moorrees & Kean 1958)

Method for recording NHP
Solow B and Tallgren, A: Natural head position in standing subjects, Acta Odontol. Scand. 1971
REHERSAL OF POSITION
BODY POSTURE
HEAD POSTURE
POSITIONING OF CEPHALOMETER
POSITIONING OF FEET
BODY POSTURE
HEAD POSTURE
ADJUSTMENT OF SYMMETRY

Other methods
Fluid level device..

Inclinometer…
Posture during cephalometric radiographs
Patient standing with cephalostat ear rods places on external auditory meatus..

The nose clamp was fixed at the root of nose to support the upper part of the face.
Mid sagittal plane of patient is vertical & is parallel to the film plane and both of these are perpendicular to the x ray beam.
Patients FH plane parallel to floor.
For PA cephalogram the patient is rotated 90 degrees (facing the film).
FH plane

FACTORS AFFECTING THE RADIOGRAPHS
MAGNIFICATION:
X ray photons emit in divergent pattern..
Degree of magnification is determined by the ratio of x ray source to object distance and the source to the film distance.
Larger the distance from the film plane greater the magnification.

Rectification :
The distance from the x ray source to the mid sagittal plane of the patients head in cephalometric units is 5 feet.
This ensures that the x ray photons are travelling towards the object / film more parallel to eachother thus reducing the magnification.
The distance between the Midsagittal plane of the cephalostat and film cassette should be 15cm.

The inevitable ……
Still the magnification persists in the most of the oral & craniofacial structures ranging from near zero for objects close to the film and in the exact centre of the x ray beam of 24% at regions 60mm from each rods and beyond. (but even this % is not constant in all cases)
Close to film less magnified and close to the beam more magnification.
X ray artifacts
Artifacts can present in a variety of ways including abnormal shadow noted on a radiograph or degraded image quality and have been produced by artificial means from hardware failure, operator error and software (post-processing) artifacts.

There are common and distinct artifacts for film, computed and digital radiography.

Common causes
improper handling of the films
errors while processing the films
patient movement while taking the shoot
Common artifacts (film and computed/digital radiography)
motion artifact - due patient movement resulting in distorted image

image compositing (or twin/double exposure) - superimposition of two structures from different locations due to double exposure of same film/plate
grid cut-off
radio-opaque objects on or external to patient (e.g. necklaces, piercings, buttons)

Film radiography artifacts
finger marks - from improper handling with hands
clear film - due to malfunction of machine or placing film in fixer before developer solution
static electricity - black "lightning" marks resulting from films forcibly unwrapped or excessive flexing of film
crescent-shaped black lines - due to fingernail pressure on the film
crescent-shaped white lines - due to cracked intensifying screen
black film - due to complete exposure to light.
clear spots
air bubbles sticking to film during processing

fixer splashed on film prior to developing
dirt on the intensifying screen
Computed/digital radiography artifacts
detector image lag or ghosting - latent image from previous exposure present on current exposure
backscatter - due to increased radiation exposure required for portable DR examinations
stitching artifacts - occur when two separate DR or CR images are merged into a single image

Radiation protection

Use of high speed film and intensifying screens.
Filtration of scattered radiation by aluminium filter.
Collimation by a diaphragm made of lead in order to achieve the optimum beam size.
Proper exposure technique and avoid repetition.
Patient and operator wearing lead apron
Operator standing at least 6 feet behind x ray tube.

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Radiographic cephalometry – Alexander Jacobson.

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