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ORIGINAL RESEARCH

Discrepancies in cephalometric measurements in relation to natural head position

Discrepancias en medidas cefalométricas en relación a la posición natural de la cabeza

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ABSTRACT

The objective of this study was to determine the cephalometric discrepancy of some reference planes and angles in relation to the natural head position. 78 patients were admitted at the Orthodontic Service of the Mexico Children's Hospital and 2 lateral X-rays were taken from the skull of each patient. The first radiograph was in natural position. The patient positioned his head in a relaxed way looking into the horizon, with slightly separated legs, arms resting at the sides of the body, lips at rest. The second radiograph (assisted) was taken with the above mentioned parameters and without the olives pressing the external auditory meatus. A 4 x 8 cm to 1.5 m mirror was given to each patient of so that they could look into it with his or her pupils focused in the eye center and a plummet placed on the chassis of the plate (representing the true vertical) plus a profile photograph with the same indications. The measurements in both plates were traced, measured and compared. We considered the random error with a standard deviation of 0.4 mm, Houston's.[1] **Results:** We found a statistically significant difference ($p = 0.004$) between the Frankfort plane and the true horizontal and ($p < 0.005$) between nasion perpendicular to point A and between subnasal vertical to pg' in relation to the Frankfort plane and to the true horizontal unlike facial depth ($p = 0.545$).

RESUMEN

El propósito del estudio es determinar la discrepancia cefalométrica de algunos planos y ángulos de referencia con relación a la posición natural de la cabeza. Seleccionamos los 78 pacientes que ingresaron al Servicio de Ortodoncia del Hospital infantil de México en el 2004, tomamos 2 telerradiografías por cada paciente. La primera con postura natural, el paciente posicionó su cabeza de manera relajada mirando hacia el horizonte, piernas ligeramente separadas, los brazos al costado del cuerpo, labios en reposo. La segunda (asistida) con los mismos parámetros mencionados sin que las olivas presionaran el conducto auditivo externo, adicionándole un espejo de 4 x 8 cm a 1.5 m para que el paciente mire con sus pupilas en el centro del ojo y una plomada colocada sobre el chasis de la placa (representando la vertical verdadera) más una fotografía de perfil con las mismas indicaciones. Se trazaron, midieron y compararon ambas placas. Consideramos el error aleatorio con una desviación estándar de 0.4 mm según Houston.[1] **Resultados:** Encontramos diferencias estadísticamente significativas ($p = 0.004$) entre Frankfort y la horizontal verdadera y ($p < 0.005$) en nasión perpendicular/punto A y vertical a subnasal/pg' en relación al plano de Frankfort y a la horizontal verdadera a diferencia de la profundidad facial ($p = 0.545$).

Key words: Frankfort plane, true horizontal plane, natural head position and natural head posture.
Palabras clave: Plano de Frankfort, horizontal verdadera, posición y postura natural de la cabeza.

INTRODUCTION

The natural head position (NHP) is defined as an innate, physiological and reproducible position of the head obtained when the patient is in a relaxed position, sitting or standing, looking into the horizon or into an external reference point (a mirror, a mark on the wall) at eye level. It is known as the auto balance head position or natural orientation. It is important to distinguish between natural position and natural posture since posture is used to study the relationship between morphology and function, usually defined as a position in which the patient is standing keeping his or her head on its own balance in a non-strained position for a specific activity at some time.[2-14]

The concept of natural head position is not new. Leonardo da Vinci (1452-1519) and Albrecht Dürer (1471-1528) used horizontal and vertical lines on paintings of models positioned in a «natural pose» so that the artistic and scientific replica of human heads was secured. In the XIX century, Von Baer, Wagner

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and Broca defined the natural posture of the head as the subject's posture when they are standing with their horizontal visual axis.[4]

Currently, lateral radiographs are one of the most important diagnosis elements and auxiliaries. With them cephalometry, which is a study that measures the skull, the face, maxillary bones and dental positions, is performed and helps the orthodontist in obtaining a more profound knowledge of the structures on which he or she works by visualizing, like in a showcase, what lies beneath the soft tissues.[15,16]

The Frankfort Horizontal Plane (FHP) is one of the most used planes in cephalometry. It was adopted with the purpose of orienting the skull in a similar way to the natural head position. In cephalometric practice this plane presents two difficulties: a) Problems in locating accurately its two reference points, especially Porion, b) The operator assumesthat the Frankfurt plane is parallel to the true horizontal plane which does not occur in many individuals, there have been observed differences of up to 10 degrees and even more.[17] Arnett mentions:[18] no one walks with the Frankfort plane parallel to the ground and we can have a patient in natural head position but with the Frankfurt Plane inclined upwards or downwards *(Figure 1)*.

The Frankfort plane and others have been criticized by clinicians and investigators because of their lack of required stability but none of the suggested options has a rigorous certainty.[15] Measurements such as Sella-Nasion- Point A, Maxillary Depth, Facial Depth, etc. do not correlate or correspond to the patient's real malocclusion.[2,4,19-26]

Sometimes we observe that lateral radiographs show us that the patient's head is inclined upwards or downwards without respecting the Natural Head Position concept thus altering the position of some cephalometric landmarks such as Pogonion, Menton, etc. useful for measuring a protrusion or prognathism (Class III) or a mandibular retrusion that might suggest a skeletal Class II due to mandibular deficiency and the real appreciation of the patient's profile is lost.

Every time there is doubt regarding the correct position of the head in the lateral radiograph there is the possibility of controlling this problem by using the profile photograph.[2,20,25]

Every successful treatment is related directly to a correct diagnosis, the correct position of the lateral radiograph will help us obtain a reliable diagnosis for the precise application of the therapeutic measures.

The importance of this study lies in comparing two methods for taking lateral radiographs so that the clinician is able to obtain or achieve precise and reliable cephalometric tracings, increasing the reliability of cephalometry and thus obtaining a better diagnosis.

METHODS

The design of this study was transverse and comparative.

All 9 to 15-year-old patients that attended during 2004 to the Orthodontic Service were selected, being a total of 78 patients (sample available in the 2004 annual records) *(Figure 2).*

Two lateral head films were taken by the same operator (radiology technician) to each one of the 78 patients with the Soreedex cephalostat from the Orthodontic Service of the Children's Hospital of

Figure 1. Frankfurt plane in different head positions.

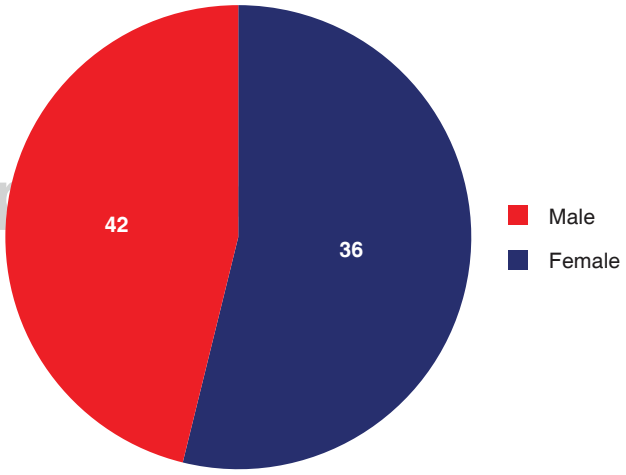

Figure 2. Distribution by gender.