

Natural head position: A review

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Article DOI: <https://doi.org/10.26477/jbcd.v32i3.2896>

ABSTRACT

Objectives: Although the Frankfort Horizontal (FH) and sella-nasion were routinely used as craniofacial reference planes, the inter-individual orientations were changeable when related to true horizontal (HOR). Natural head position (NHP) is a reproducible, standardized position, with the head in an upright posture and eyes focused on a point in the distance at eye level so that the visual axis is horizontal. The natural head position has importance in anthropological as well as in orthodontic fields, as this position has a relatively fixed relationship to the true horizontal and vertical planes. However, NHP is clinically not simple and it takes long time to be recorded, in addition to a deficiency in the tools utilized in the NHP and lack in the staff training. This paper aims to shed the light on different methods of NHP registration and reproduction.

Data and Sources: A literature review of English articles was performed using PubMed, Scopus, and Google Scholar to search for natural head position in orthodontics.

Conclusions: NHP is affected by many factors, and it is different in walking state than in static state. There are various cephalometric or photographic methods for NHP recording.

Keywords: Reproducibility of natural head position, True horizontal, True vertical plane. (Received: 25/7/2019; Accepted: 25/8/2019)

INTRODUCTION

When a person is looking at a far point at eye level with a standardized orientation of the head in space, this is called natural head position (NHP),⁽¹⁾ or at the distant objects like the light source at eye level or one's eyes reflection in a mirror.⁽²⁾ The functional position of the head that differs in the sitting and standing subject and it oscillates around the individual's mean. NHP is also known as natural head posture. Moorrees and Kean⁽³⁾ were the first to explain the natural head orientation and rectified the people with "tenseness" in their natural head position. Lundström and Lundström⁽⁴⁾ defined it as when the doctor assists the subject to orient his head, according to the clinical expertise, when body of the person is relaxed and he is looking at a distant point at level of the vision.

The natural head posture concept is not modern. Leonardo da Vinci (1452- 1519) and Albrecht Dürer (1471-1528) used scaffoldings of horizontal and vertical lines on drawings of models positioned in "natural pose" to allow more precise scientific and artistic replication of the human head.⁽⁵⁾ Sella- nasion (SN) plane is a commonly used craniofacial reference plane.⁽⁶⁾ This plane represented the anterior cranial base; so it is reliable, biologically meaningful and when concerned to vertical plane it has large inter-individual standard deviations.⁽⁴⁾

The Frankfort horizontal is not used for orienting natural head position, but it is very useful in skull investigations because the Frankfort plane is positioned in the living and it is usually distributed around extra cranial horizontal.⁽¹⁾ An extra cranial reference line is used instead of intracranial reference lines, so the natural head position (NHP) is regarded as the basis of meaningful cephalometric analysis that is subjected to large biological changes in their gradient.⁽⁷⁾

Natural head position has been used by some of anatomists and anthropologists to study the human face throughout the ages. Craniologists realized that skulls also had to be oriented in a way approximating the natural head position of the living.

The natural head position has been involved in conducting important comparative studies of crania from various racial populations. Also, to define a plane for orienting crania in a manner conforming to the natural head position of the living. Interest concentrates on presence of a posterior landmark for a plane through the lowest part of the orbits that would approximate a true horizontal extra cranial plane. Porion was taken as the most appropriate landmark.⁽¹⁾

Madsen⁽²⁾ showed that the comparison of the craniofacial morphological elements of morphology to selected reference planes was considered as a base of contemporary cephalometric analysis in orthodontics. Preferably, a valid cephalometric reference plane system should have many properties: intra-individual reproducibility and reliability (low method error), perfection, the direction in average close to true vertical (VER) or true horizontal (HOR) and low inter-individual variability. The aim of this review is to shed the light on different methods of NHP registration and reproduction.

FACTORS AFFECTING NATURAL HEAD POSITION

There are many environmental and physiological factors affecting natural head position. These factors include:

1. Respiratory Resistance

Vig et al.⁽⁸⁾ explained three experiments through their study about experimental manipulation of head posture, dealing with the effect of visual feedback deprivation, total nasal obstruction and a combination of two on the posture of the cranium measured relative to a gravity-defined true vertical reference plane. They found that total nasal obstruction results in all cases in an extended head position.

2. Craniofacial Morphology:

The natural head orientation (NHO) is influenced by the facial morphology, and the chin position is a substantial factor affecting the NHO consistently.⁽⁹⁾

3. Walking:

By means of eyewear inclinometer measurements, Usmez et al.⁽¹⁰⁾ studied the relationship between static natural head position and head position measured during walking and they compared walking with rigid head position. The mean walking head position was 4.6° inverted compared with the mean rigid head position.

4. Altered Vision:

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Studies have shown that head posture is dependent on vision. The head posture of normal subjects therefore can be anticipated to vary from that of blind subjects. Many experiments showed more difference in head posture of the blind subjects. Also, the head was tilted down in comparison to the control group⁽¹¹⁾.

METHODS OF RECORDING NATURAL HEAD POSITION

Von Baer (1861)⁽¹²⁾ described the first method for recording NHP, which was early work in the mirror guided visual technique of obtaining NHP. It seemed to be an accepted technique. In this method the persons sit on a chair comfortably and relaxed, they were asked to look into a mirror to see the image of their eyes, this mirror was founded at the same level with the pupils of their eyes. Downs⁽¹³⁾ provided a rational means of soft tissue profile typing clarifying harmonious dentofacial profiles from inharmonious ones. The lateral head profiles of 100 children had been photographed when standing and looking at their own eyes into a mirror. When those persons had no horizontal Frankfort plane, a correction was made for them, and also if the discrepancies between facial typing disappear.

Self-balance position was got when the subject had the subject's own feeling of natural head balance after head tilting exercises (moving their head back and forth) with little capacity.⁽¹⁴⁾ The NHP had been transformed to a lateral cephalometric film by a method of photography. This was achieved by applying Mølhave's orthoposition to record a NHP for 52 persons when they stood looking into their eyes on a vertical mirror 1 m away, and teeth occlusion was made in centric slightly.⁽¹⁵⁾ A fluid level device began to be used firstly by Showfety et al.⁽¹⁶⁾ when the NHP of the subjects were put in the cephalostat when taking a lateral head film exposure. This small fluid device was mounted on a small pivot bracket and linked to the temple of the subject with double sided tape (Fig. 1). The film had been exposed, when the subjects were directed to walk into the cephalostat, and the fluid level should be horizontal by could be used firstly by Showfety et al.⁽¹⁶⁾ when the NHP of the subjects was put in the cephalostat when taking a lateral head film exposure. This small fluid device was mounted on a small pivot bracket and linked to the temple of the subject with double sided tape (Fig. 1). The film was exposed when the subjects were directed to walk into the cephalostat, and the fluid level should be horizontal by resetting the inclination of subject's head.

Another study⁽¹⁰⁾ used two inclinometers, one of them was put by pitch on one arm of the spectacles, and another represented the roll fixed on the other arm (Fig. 2). While wearing the spectacles, the subjects were instructed to look into their eyes where they stood in front of a wall fixed mirror 1 m away.

What is Reproducibility of Natural Head Position?

Bjern⁽¹⁸⁾ recorded 35 subjects in NHP on three detached occasions to estimate the reproducibility of NHP. There was something wrong in the analysis method. There were differences between the maximum and minimum values of the 3 determinations of the angle SN/HOR that were studied for standing persons. The reliability of the dental Auxiliaries use in a routine method of recording the NHP could be examined. The material was comprised thirty orthodontic patients recorded on two occasions 1 to 35 days apart. The first and the second recordings for the patients were examined showing no systematic difference.⁽¹⁹⁾

resetting the inclination of subject's head

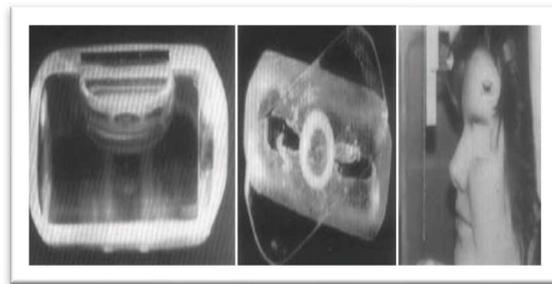


Figure 1: The Showfety fluid level, pivot hinge, and fluid level fixed to subject's temple⁽¹⁶⁾.

Raju et al.⁽¹⁷⁾ transferred the true vertical reference line on the patients face itself in NHP to the conventional lateral cephalogram in a modified approach of the capture, in which a mirror 4x2 feet in size was fixed on the wall and the suspending weight of 4 kg on a 0.016 inch wire hung from the ceiling in front of the mirror as a plumb line was created to represent the true vertical.



Figure 2: Two inclinometers for pitch and roll fixed to a pair of spectacles⁽¹⁰⁾

The validity and precision of NHO was estimated by Lundström and Lundström.⁽²⁰⁾ They cut 27 lateral profile photographs of orthodontic patients into round forms and the orientation of these photographs were inspected by four examiners in natural head. They found a high correlation in orientating these profile photographs in evaluated NHP.

The longitudinal reproducibility of NHP had been investigated primarily by Cooke & Wie.⁽²¹⁾ Their findings showed no significant differences when recording the NHP with or without ear posts use, but with a mirror the NHP reproducibility was better (method error 1.9°) than without a mirror (method error 2.7°).

Advantages of NHP

- The inclination of an intracranial reference line was subjected to large biological changes more than the extra-cranial reference lines so these lines are used instead of intracranial ones, therefore, natural head position (NHP) was regarded as a base for cephalometric analysis⁽⁷⁾.
- Its ease of recording and representation of a true life appearance⁽²²⁾.
- The primary basis used in cephalometric analysis is the NHP (and a true vertical/horizontal), because this reference plane is efficient, more stable and gives a more significant cephalometric analysis and more

clinically pertinent diagnosis of skeleton-facial discrepancies.⁽²³⁾

- The important feature of the NHP: its intra-individual reproducibility is significantly less than the inter-individual variability of conventional craniofacial reference planes, when both related to true vertical.⁽²⁴⁾

Disadvantages of NHP

- Natural Head Position is not particularly simple in the clinical field; moreover, it is time consuming⁽²⁵⁾.
- Some people hold their head in an extended unnaturally or flexed position that may lead to faulty results if used for diagnosis⁽⁹⁾.
- There was a practical constraint in workers practice and equipment used in NHP recording, therefore, it is not widespread⁽²⁾.

CONCLUSION

The use of NHP as a craniofacial system represents a correct alteration of classical craniofacial reference planes since it truly represents the head orientation, registered easily, and it has good intra-individual reproducibility.

Natural head position has essential importance to orthodontists before facial cephalograms taking; it has been shown to be the most accurate and reproducible head position. Moreover, there are different applications of NHP in orthodontic sphere for diagnosis and research purposes. Many methods are used to register the NHP, these methods are conducted either by cephalometric X-Ray or photographs.

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المستخلص

من الشائع استخدام المستويات المرجعية القحفية مثل فرانكفورت الافقي وسيلا ناسون. هذه المستويات لها توجيه متغير بين الافراد عندما تكون ذات صلة بالافقي الحقيقي. وضع الراس الطبيعي هو وضع موحد قابل للتكرار عندما يكون الراس بوضع مستقيم و العينين مركزة على نقطة على مسافة بمستوى العينين بحث يكون المحور البصري افقي. وضع الراس الطبيعي له اهمية في مجال علم الانسان اضافة الى مجال تقويم الاسنان. هذا الوضع لديه علاقة نسبية مع المستوى الافقي والعمودي الحقيقي. لكن وضع الراس الطبيعي سريريا ليس باليسيط ويستغرق وقتا طويلا عند تسجيله. بالاضافة الى ذلك هناك نقص بالادوات المستعملة بوضع الراس الطبيعي والافتقار الى كادر متدرب. وضع الراس الطبيعي يتاثر بعدة عوامل هو مختلف بحالة المشي عنه بحالة الثبات. هنالك طرق متنوعة تستعمل لتسجيل وضع الراس الطبيعي هذه الطرق قد تكون عن طريق الاشعة الجانبية او طرق تصويرية.