Ortopantomographic Blind Test of Mandibular Ramus Flexure as a Morphological Indicator of Sex in Chilean Young Adults

Test Ciego con Ortopantomografía de la Flexura de la Rama Mandibular como un Indicador de Sexo en Adultos Jóvenes Chilenos

*Iván Claudio Suazo Galdames; *Jaime San Pedro Valenzuela; **Nilo Alejandro Schilling Quezada; **César Eduardo Celis Contreras; **José Alejandro Hidalgo Rivas & *Mario Cantín López

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SUMMARY: Loth & Henneberg (1996) described a simple morphological feature for sex determination by observing the flexure of the posterior margin of the mandibular ramus, at the level of the plane occlusal. The purpose of this study is to analyze the level of agreement for determining the sex by observing the parameters described by Loth and Henneberg, in ortopantomography of totally dentate Chilean young adults. This study is based on 188 files of ortopantomography acquired from the Department of Radiology of the Dental School of Universidad de Talca, Chile. In brief, our studies indicated that in the ortopantomography of females 63.25% (62-64.5%) was correctly sexed, whereas the prediction accuracy was only 48.25% (46.5–50%) for men. The success percentages were lower than those reported by Loth and Henneberg, which justifies the necessity to evaluate the methods of anthropological–forensic analysis that are used in our population.

KEY WORDS: Mandible; Sex assessment; Blind test.

INTRODUCTION

The diagnosis of sex is a necessary stage in forensic evaluation. Rösing *et al.* (2007) recommended a first evaluation phase by a simple method of morphologic character before moving to the second phase of molecular analysis. In the morphologic analysis of human bones, pelvis and skull bones account for a major amount of information for sex determination.

Loth & Henneberg (1996) described a simple and highly accurate method for sex determination, through the posterior edge flexure at the level of the occlusal plane in mandibular ramus observation. In agreement with the authors, the mandibular ramus posterior edge exhibits a flexure in the mandibles of adult males, which is absent in the mandibles of females or is on a different level to the occlusal plane. The above method has been questioned and subjected to validation by different authors, with mixed results (Koski, 1996; Coqueugniot & Bruzek, 1997; Donnelly *et al.*, 1998; Indrayana *et al.*, 1998; Haun, 2000; Hill, 2000;

Balci *et al.*, 2005), but less than 99% of correspondence was reported by Loth & Henneberg (1996). According to Kemkes-Grottenthaler *et al.* (2002), the mandibular tooth loss and functional changes can influence the determination of the age by the Loth & Henneberg method. The features described have been analyzed in the mandibles of subadults too (Loth & Henneberg, 2001; Franklin *et al.*, 2007).

Few studies have referred to the features of dimorphism in the South American population (Esteves, 1977); according to Steyn & Iscan (1988), the variations in the skeletal characteristics of different populations can interfere in the diagnosis of sex. Rösing *et al.* indicate that the robusticity or thinness of the musculature, which determines some visible traits in the skeleton, depends on regional factors.

The identification of posterior edge flexure mandibular ramus is possible through ortopantomographic observation.

* Department of Normal Anatomy, Faculty of Health Science, Universidad de Talca, Chile.

** Department of Stomatology, Faculty of Health Science, Universidad de Talca, Chile.

The purpose of this study is to analyze the consistency level for determining sex by observing the parameters described by Loth & Henneberg (1996) in the ortopantomography of completely dentate Chilean young adults.

MATERIAL AND METHOD

In this study, 188 files of ortopantomography from the Oral and Maxillofacial Radiology Service, Dental School of Universidad de Talca, were used. All radiographs corresponded to completely dentate Chilean adults, with an average age of 21.13 years (SD 1.25), of which 108 were female and 80 were male, who required diagnosis for the purpose of dental restoration. The sample was evaluated by two observers, who were oral maxillofacial radiological specialists. Instructions on how to evaluate the images were derived from the description of the Loth & Henneberg method (1996, 2000). First the flexure in the mandibles was observed directly and then the flexure in the ortopantomography was observed. Radiologists analyzed the presence or absence of flexure and its level with regard to the occlusal plane.

Each ortopantomography was projected on a negatoscopy for analysis; no evidence of sex was visible in the image diagnosed. Each radiologist independently noted its sample and identified the mandibular ramus posterior edge; if the flexure was present at the level of occlusal plane it was diagnosed as +1 (Fig.1), -1 if flexure was not at or

was in a different level to the occlusal plane (Fig.2), and 0 if the presence of a parameter was not clear. As in the Loth & Henneberg classification, +2, +1, and 0 were considered males, whereas -1 and -2 were diagnosed as females.

The diagnoses of each observer were compared and identified in concordance between both and each one, in connection with the sex documented radiographically in the subjects discussed.

RESULTS

In our blind test, 63.25% (62–64.5%) of the ortopantomography of females were correctly sexed; for the males, the prediction accuracy was only 48.25% (46.5–50%). These results are presented in Table I.

Table I. Distribution of sex diagnostic and accuracies by observer. (n=188; 108 females; 80 males).

Observer 1			
	Females	Males	Accuracies
Females	54	33	62%
Males	54	47	46.5%
Observer 2			
	Females	Males	Accuracies
Females	62	34	64.5%
Males	46	46	50%

The inter-observer concordance presents a moderate indicator, with a Kappa value of 0.457.

Fig. 1. Ortopantomography of adult male.

Fig. 2. Ortopantomography of adult female.

DISCUSSION

In our study, we found a moderate level of accuracy in diagnosing the sex by observing the posterior edge of the mandibular ramus in adult Chilean ortopantomographies. Our results were better for the diagnosis of sex in females than in males, in comparison to what was reported by different authors on work performed directly on the mandibles (Coqueugniot & Bruzek; Donnelly *et al.*; Indrayana *et al.*; Haun; Scheuer, 2002).

In our study, it is clear that the accuracy in determining sex is very different from the excellent results reported by Loth & Henneberg (1996) in their original article, which interacts with the radiographic image distortion, inherent to the technique and the equipment used, but in any case agrees with numerous articles that have questioned the accuracy of the method (Koski; Coqueugniot & Bruzek; Donnelly *et al.*; Indrayana *et al.*; Haun; Hill; Kemkes-Grottenthaler *et al.*; Balci *et al.*), indicating that the posterior edge ramus flexure cannot be used as a single indicator of sex in unknown skeletal remains (Oettle *et al.*, 2005). In our sample, only one subject was completely edentate. Kemkes-Grottenthaler *et al.* indicated that tooth loss lowered the values of accuracy in the analyzed method. The age of the analyzed subjects is an important factor to consider. Our study analyzes ortopantomography of young adult subjects (mean: 21.13 years) with a low dispersion (SD 1.25). According to Okeson (2003), the forces of the

elevator muscles are highest in young adults, which is a determinant in the modeling of the mandibular ramus (Koski) and one of the causes of development in the mandibular ramus flexure (Loth & Henneberg, 1996).

Our results confirm the need to assess the anthropological-forensic analysis methods used in our population.

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RESUMEN: Loth & Henneberg (1996) describieron un sencillo indicador morfológico para la determinación del sexo, mediante la observación de una flexura en el borde posterior de la rama mandibular, a nivel del plano oclusal. El propósito de este estudio fue analizar el nivel de concordancia para la determinación del sexo, mediante la observación de parámetro descrito por Loth & Henneberg, en ortopantomografías de sujetos adultos jóvenes, chilenos, completamente dentados. Se utilizaron 188 ortopantomografías de los archivos del Servicio de Radiología de la Escuela Dental de la Universidad de Talca, Chile. En nuestro estudio, las ortopantomografías de mujeres fueron clasificadas correctamente en un 63,25% de los casos (62-64,5%); para los hombres, la predicción de exactitud sólo fue de 48,25% (46,5 -50%). Los porcentajes de acierto fueron inferiores a los comunicados por Loth & Henneberg, lo que justifica la necesidad de evaluar los métodos de análisis en antropología forense que se utilizan en nuestra población.

PALABRAS CLAVE: Mandíbula; Estimación de sexo; Test ciego.

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Correspondence to:
Prof. Dr. Iván Suazo Galdames
Departamento de Anatomía Normal
Universidad de Talca
Lircay s/n oficina 104
Talca - CHILE

Phone 56-71-201682
Fax 56-71-201452

Email: isuazo@utalca.cl

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