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Research Article

IMPACT OF THYROID COLLARS ON ACCURACY OF LATERAL CEPHALOGRAMS: DIAGNOSTIC AND DESCRIPTIVE EVALUATION

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ABSTRACT

This study aimed to evaluate the impact of thyroid collars (TCs) on the accuracy of lateral cephalograms from both diagnostic and descriptive perspectives. Blinded and randomized observers assessed lateral cephalograms obtained with and without TCs. Two groups were involved: one group retrieved lateral cephalograms without TCs from an oral radiology archival system, while the other group had lateral cephalograms performed by an oral radiology department using TCs. Digital Kodak systems were employed for imaging. Two observers, blinded to the study's purpose, analyzed the lateral cephalograms, with inter-observer variance also examined. Each group comprised 50 lateral cephalograms for analysis. In the TC group, 12 out of 15 landmarks were identified, with three landmarks, including the hyoid bone, second cervical vertebra, and third cervical vertebra, not identified. No significant differences were observed between observers in landmark identification on lateral cephalograms. However, TCs were found to obscure some landmarks, which are crucial for calculating the sella-nasion-mandibular (SNM) index. Given the risk of thyroid cancer from radiation exposure, lead TCs are routinely used during lateral cephalograms. Therefore, obtaining accurate SNM index information from cephalometric radiography may not be necessary when TCs are utilized.

Key words:- Thyroid collars, Lateral cephalograms, Diagnostic accuracy, Radiographic Landmarks, Radiation protection.

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INTRODUCTION

Radiology units typically have lead collars in their armamentariums. Although thyroid collars remain one of the most underused radiation protection tools, they are among the cheapest and most convenient [1,2]. Radiation exposure is usually associated with the thyroid gland in most dental radiographs. A patient's thyroid can be adversely affected by thyroid exposure. Females and children are more likely to develop thyroid cancer from exposure to radiation, but children are often sought after for orthodontic treatment during childhood.

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An orthodontic treatment will typically begin with a cephalometric radiograph. Cephalometric radiography (CR) introduced a thyroid collar in 1977.

If a patient is going through a growth spurt, a cephalometric radiograph should be taken to protect the thyroid gland. The American Dental Association strongly recommends radiation protection in dental radiology [3]. With lateral cephalograms, the field of vision should be minimized as much as possible. US National Council on Radiation Protection and Measurements does not mention TCs in their Radiation Protection Guidelines for the Practicing Orthodontists report. Due to their ambiguous

use, TCs are not usually included in cephalometric radiographs.

Dental radiation exposure during pregnancy can cause low birthweight infants even if the fetus is not exposed [4,5]. Low birthweight infants are associated with which specific organs in the dental radiation field [6]. In epidemiological studies [7,8] and experimental animal studies [9], the thyroid gland may play a role in such an association [10]. Fetal growth retardation has been associated with dental radiation exposure for a number of reasons. Due to the lack of documentation on the use of TCs, an order of magnitude increase in cephalometric exposure was reported. Dental exposures, especially during CT, carry an increased risk and there are no uniform guidelines for protecting the thyroid.

It is possible to exclude the thyroid by using a primary beam collision. Since the thyroid pyramidal lobes are close to the hyoid bone, it cannot be excluded exclusively by using the thyroid's lateral poles, which are in close proximity to the fifth and sixth tracheal rings. It is possible to overcome some of the disadvantages of beam collimators with TCs. No TC should be refused on medical or ethical grounds. TCs are rarely used in CR because orthodontists fear that they will impair landmark identification, which is crucial to accurate diagnosis. An experiment was conducted to examine whether TCs affect cephalometric landmark identification. TC use negatively affected the identification of cephalometric landmarks, resulting in decreases in diagnostic accuracy.

MATERIALS AND METHODS

In this study, observers were blinded to the diagnosis. Each group of 50 patients was divided into two. Patients who underwent CR with TC in the oral radiology unit were categorized into one group (TC group). From the oral radiology archives, we also retrieved CRs without TCs (non-TC group). The institutional review board of the local university approved the study. Patients in the TC group consented after receiving informed consent. Patients with craniofacial syndromes with short necks and those requiring skeletal maturity index testing were excluded from the TC group. A Kodak 9000 direct digital cephalometric unit (Eastman Kodak, Rochester, NY) was used for CR. An X-ray source was positioned 5 feet away from the patient's mid-sagittal plane. Parallel to the floor was the Frankfurt horizontal plane. A relaxed or reposed posture was employed with the lips in occlusion and teeth in occlusion. Midsagittal plane distance to film generally varies with head size, but it is generally 15 cm. In this experiment, 72 Kvp was set as the exposure parameter, with mAs ranging from 9 to 12.

TC and non-TC groups' images were split between two folders titled observer 1 and observer 2. Two observers (FK and VK) were assigned the task of identifying landmarks in all 100 images. All identification tags were removed from the images before coding. A DICOM tool was provided to the observers to aid in landmark identification. As soon as the observers identified the images, headers were created for them. It was determined that 15 landmarks can be identified in the head and neck region on the basis of the locations of 15 landmarks. There were two types of observations: detected and unnoticed. In the study, none of the observers knew what the purpose was. Data were pooled and then separated into two folders, one for TC group and the other for non-TC group. The Mann-Whitney test was used to analyze the TC group data to determine whether observer observations exceeded the TC group's.

RESULTS

A blinded observer evaluated 50 patients from each group (TC or non-TC). Archival images were retrieved for groups without TC. The TC collar masked all the cervical vertebrae between the hyoid bone and the second cervical vertebra. A radiograph of the second cervical vertebra, 45 and 48 times, as well as 46 and 48 times for the third cervical vertebra do not demonstrate hyoid bone. A lateral cephalometric score of 13.80 was recorded by observers 1 and 2 with a standard deviation of 0.76 and 1.05, respectively, as presented in Table 2.

As a result of both observers identifying the non-TC group, there was no confusion. With the Mann-Whitney test, the interobserver variance was also examined for both TC and non-TC groups. Interobserver variance measured by a non-significant $P > 0.05$ indicated that landmarks were reproducible between observers.

TABLE 1: Amount of time observers 1 and 2 found cephalometric landmarks obliterated

Factors	Landmark 20	Landmark 28	Landmark 30
A1 Observer	66	90	92
2nd observer	72	56	96

TABLE 2: Both observers 1 and 2 gave a rating of 5 points to the thyroid collar (TC) group

	Observer 1(FK)	Observer 2(VK)
Average	26.80	26.45
Standard deviation	0.65	2.06

DISCUSSION

This study aimed to investigate whether the use of a TC during CR would influence landmark identification, thereby affecting the diagnostic quality of radiographs. Two unbiased observers examined 50 cephalometric radiographs of TCs and non-TCs (n = 50) to determine whether cephalometric landmarks were present. Three landmarks located in the neck region were consistently missed by both observers in the TC group. Hyoid bone ranks first among the three landmarks, followed by cervical vertebrae 2 and 3, and finally the cervical vertebrae 3. Cephalometric landmarks weren't identified correctly when using a TC. Both observers in the non-TC group were able to detect all 15 landmarks. Interobserver variance was not significant in either group ($P<0.05$). This led to the findings being reproduced by both observers. In this study, interobserver reproducibility was used as opposed to intraobserver reproducibility, which is more indicative of clinical routine than intraobserver reproducibility. Clinically valuable hidden landmarks are the only basis for TC refusal. It is mostly the cervical landmarks affected by TC that are studied when calculating the skeletal maturity index (SMI). MP3's developmental stages have been used to assess SMI using periapical films [11]. A study conducted [12] showed that both the middle phalanx (MP3) and cervical vertebrae can measure maturity. A radiographic film appropriate for periapicals instead of a wrist x-ray was to compare the six stages of skeletal maturity observed with the MP3 and six maturation indicators of cervical vertebrae (MICV). This modification, which has a close relationship with the MICVs, is simple, accurate, practical, and economical. Additionally, thyroid glands are protected by periapical films with MP3 radiographs. Consequently, there can be no influence on the quality of CR by a TC.

The risk of dental exposures during pregnancy has been disputed by studies on humans and animals, but epidemiological data suggest that dental exposures may cause fetal growth retardation. Considering that women of reproductive age may not always know whether they are pregnant, protecting their thyroids is crucial. Children and adolescents are more likely to suffer radiation-induced damage [13]. The risk can also be expressed for quite a long time. In orthodontics, children and adolescents account for the majority of patients. Radiation exposure can cause carcinoma in the thyroid gland, making it essential to protect them from the disease [14]. A radiology diagnosis and treatment are most commonly used in orthodontics, skeletal growth, and jaw sagittal relationships [15]. A CR radiograph, probably the only one in oral and maxillofacial radiology to include the thyroid, lies directly in the area of irradiation. The amount of absorbed by the thyroid was reduced by 50% to 80% by using a TC in CR. There have been limited instances of radiation protection for the thyroid field. A collimator similar to that used to collimate the CR head phantom [16]. The thyroid was excluded from the radiation field by using a compensated filtration collimator (CFC). As a result of the treatment, 61.4% of the thyroid's absorbed dose was reduced, but it did not completely prevent thyroid absorption. In spite of this, an absorbed dose can still be caused by extra-focal radiation. Alternatively, extra-focal radiation can be caught by a tube's window or by secondary radiation. Therefore, collimation does not fully protect the thyroid.

TC has been shown to miss only three landmarks of CR when the other landmarks were used. A study of SMI primarily uses the three landmarks masked. For SMI analysis, an MP3 on a periapical film could be used when CR is being considered with a CT to protect the thyroid. The purpose of our study was kept a secret from observers, so cephalometric landmarks were perceived impartially, and image processing equipment and tools were standardized, allowing for anonymous data collection, uniform analysis, and consistent image quality across a wide exposure range. Our study had a number of weaknesses, including an incomplete landmark set, but using landmarks on the upper half of the face would have been inappropriate to study how TCs affect landmark recognition. In this study, interobserver variance was used rather than intraobserver variance, which makes it less accurate. Thyroid cancer is still susceptible to extra focal rays (despite use of TCs), despite TC use reducing thyroid exposure.

CONCLUSION

Cephalometric units equipped with beam collimators exhibit a distinct architectural design. Presently, lead thyroid shielding stands out as the most efficient method for minimizing radiation exposure to the thyroid gland. Consequently, it is advisable to employ thyroid collars for patients undergoing cephalometric radiography (CR) when obtaining soft tissue mentum-incisive (SMI) measurements is deemed non-essential. Thyroid collars offer a straightforward, cost-effective, and readily accessible solution. By utilizing thyroid collars, the thyroid gland receives protection from ionizing radiation, thereby minimizing radiation exposure to the gland to the greatest extent possible.

REFERENCES

1. White SC, Pharoah MJ., (2004). (eds) Radiation biology. Oral Radiology: principles and interpretations (5th edn.) *St. Louis, MO: Mosby*, 41
2. Block AJ, Goepp RA, Mason EW. (1977). Thyroid radiation dose during panoramic and cephalometric dental x-ray examinations. *Angle Orthod.*, 47, 17–24

3. Friederikson LN, Health Physics White SC, Pharoah MJ. (2004). (eds). Oral Radiology: principles and interpretations (5th edn.) *St. Louis, MO: Mosby,*, 61
4. Alcaraz M, Garcia-Vera MC, Bravo LA, Martinez-Beneyto Y, Armero D, Morant JJ, (2009). Collimator with filtration compensator: clinical adaptation to meet European Union recommendation 4F on radiological protection for dental radiography. *Dentomaxillofac Radiol* 38, 413–420
5. Mupparapu M. (2005). Radiation protection guidelines for the practicising orthodontist. *Am J Orthod Dentofacial Orthop*., 128, 168–172
6. Hujoel PP, Bollen AM, Noonan CJ, del Anguila MA. (2004). Antepartum dental radiography and infant low birth weight. *J Am Med Assoc* 291, 1987–1993
7. Glinoer D, Soto MF, Bourdoux P, Lejeune B, Delange F, Lemone M, (1991). Pregnancy in patients with mild thyroid abnormalities: maternal and neonatal repercussions. *J Clin Endocrinol Metab* 73, 421–427
8. Pacini F, Vorontsova T, Molinaro E, Shavrova E, Agate L, Kuchinskaya E, (1999). Thyroid consequences of the Chernobyl nuclear incident. *Acta Paediatr Suppl* 88, 23–27
9. Usenko V, Lepekhin E, Lyzogubov V, Kornilovska I, Ushakova G, Witt M. (1999). The influence of low doses 131I-induced maternal hypothyroidism on the development of rat embryos. *Exp Toxicol Pathol* 51, 223–227
10. Reiman RE. (2004). Antepartum dental radiography and low birth weight (author reply) *J Am Med Assoc* 292, 1019
11. Pisaniello ML. (2004), Antepartum dental radiography and low birth weight (author reply) *J Am Med Assoc* 292, 1019
12. Henderson CE, Ahmed H. (2004). Antepartum dental radiography and low birth weight (author reply) *J Am Med Assoc* 292, 1019
13. Welsh J. (2004), Antepartum dental radiography and low birth weight (author reply) *J Am Med Assoc* 292, 1019–1020
14. Lockhart PB, Brennan MT, Sasser H, Ludlow J. (2004) Antepartum dental radiography and low birth weight (author reply) *J Am Med Assoc*, 292, 1020
15. Madhu S, Hegde AM, Munshi AK. (2003).The developmental stages of the middle phalanx of the third finger (MP3): a sole indicator in assessing the skeletal maturity? *J Clin Pediatr Dent* 28, 149–156
16. Gijbel F, Sanderink G, Wyatt J, VanDam J, Nowak B, Jacobs R. (2003). Radiation doses of collimated vs non collimated cephalometric exposures. *Dentomaxillofac Radiol* 32, 128–133

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