Review Article

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Identification on the Basis of Radiographs

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Abstract

Radiography can play an important role in forensic dentistry, mainly to establish identification. This takes the precise form of comparison of ante-mortem and post-mortem radiographs. Radiographs also help to determine the age of a minor victim and even to help in assessment of the sex and ethnic group. In case of mass disaster comparable radiographs are an essential factor to confirm the identification in a mass disaster. This article describes the identification of unknown individual on the basis of radiographs.

Keywords: Radiography; Topography.

Estimation of Age

Estimation of Age from Teeth

The radiological age determination is based on assessment of various features as follows [1-8]:-

1. Jaw bones pre-natally;
2. Appearance of tooth germs;
3. Earliest detectable trace of mineralization or beginning of mineralization;
4. Early mineralization in various deciduous teeth during intrauterine life;
5. Degree of crown completion;
6. Eruption of the crown into the oral cavity;
7. Degree of root completion of erupted or unerupted teeth;
8. Degree of resorption of deciduous teeth;
9. Measurement of open apices in teeth;
10. Volume of pulp chamber and root canals/ formation of physiological secondary dentine;
11. Tooth-to-pulp ratio;
12. Third molar development and topography;
13. Digitization of the available radiographs for analysis of images to obtain the dental information.

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Estimation of Age from Sutures

At present, the estimation of age from the cranial and facial suture is best done by direct examination instead of by using radiographs of the skull [9]. Caffey has presented a survey of ossification and fusion of the sutures. This procedure is worth mentioning because radiography permits longitudinal studies of suture closure and may at a later date provide standards that are now lacking [10].

Estimation of Age from Size of the Skull

Roentgenographic cephalometry studies made by Broadbent, Bjork and Sassouni have proposed standards of facial size and proportions by age level. They may serve as a basis of comparison. The range of normal variation is too large, however, to permit great accuracy. Furthermore, we lack precise knowledge of the changes in the face due to aging in the adult. Tallgren has done one of the best radiographic studies of the change in facial height due to long-term wear of full dentures. He has found

a significant statistical mean difference of 13 mm in comparison with a control group of similar age [11-13].

Estimation of Age Based on Sinuses [14]

The paranasal, frontal, and sphenoidal sinuses provide sharply defined outlines easily recorded from lateral or frontal radiographs. Their developmental stages afford the possibility of the assessment of age [15]. Sedwick has stated that the maxillary sinus as seen in a posterior-anterior roentgenogram reaches its maximum size during the third decade of life and does not increase thereafter. He added that in later decades there is a tendency of the maxillary sinus to assume a triangular form [16]. Maresh in an excellent longitudinal radiographic study of the development of the paranasal sinuses has presented tracings of their standards and their variability. One should refer to his life-size illustrations. He has emphasized that variation is the rule, as the initial appearance of the sinus may range from one year of age to eight years among different individuals. Scammon and Caffey illustrate the localization, size, and expansion of the maxillary and sphenoidal sinuses [17].

Because of their variabilities the sinuses can provide additional traits to the mosaic of the puzzle in age determination. Detailed studies are still necessary on the correlation of the sinuses with cephalofacial size and pathology. In the female after menopause, Schuller has found some hyperostosis [18].

Murczynski and Sypniewska have noted also that in old females the frontal sinuses diminished with age. They have added that a negative correlation is present between the pneumatisation of frontal sinuses and lung cancer [5]. In conclusion, the estimate of age from radiographic dentocephalofacial examination can be relatively accurate when all the traits discussed previously are taken into account [19].

Estimation of Sex

Estimation of Sex from Dental Radiographs

Although many studies have divided teeth size between sexes, there is so much overlapping that it cannot be used as a discriminatory trait for individual identification. Timing of calcification differs in boys and girls, as shown in Nolla's data [20].

Hurme has pointed out that "the largest time difference in the emergence of the teeth in boys and girls is furnished by the mandibular canine which appears about eleven months earlier in the average girl than in the average boy" [21]. Hunt and Gleiser have demonstrated that age assessment is considerably improved when sex is known. If carpal assessment is possible from the remains available, both age and sex can be identified with a greater degree of confidence [22]. Witkop has described some sex-linked dominant traits (hypoplasia and hypo maturation of enamel), but these can be better evaluated by direct examination [23].

Estimation of Sex from Cephalofacial Radiographs

Krogman [24] has described certain traits distinguishing skulls of males and females. Many of these traits have not been investigated by means of radiographs, but they present potential guides. Ceballos and Rentschler have made apparently the only systematic radiographic study of identification of sex based on adult skull characteristics. They have followed a similar study made by Keen from skull material. They have used the posteroanterior projection, from which they measured four diameters: total craniofacial height, mastoid height, bicondylar width, and mandibular width. They have concluded from extensive tests that "sex can be predicted in 88 per cent of the cases by utilization of these measurements."The sinuses have not yielded much discriminatory information [25]. Sedwick has denied that the relation between the floor of the maxillary sinus and that of the nasal cavity is a characteristic of sex. Certain types of intracranial hyperostosis seem to be sex-linked and to be found predominantly in females. Similarly, certain pathologic features are considered to belong to one sex [26].

Determination of Race

Because pure race is now the exception and mixed races the rule, the determination of race still is more an art than a science [27].

Determination of Race by Dental Radiographs

Many traits best estimated by direct examination have been defined on the crown of the teeth. Very few require radiography. Lasker and Lee have referred to the pulp cavity in the Mongoloid race as exceptionally wide and deep [28].

Hurme has compared dental-eruption analysis from Japanese sources with his own compilation. His evaluation is that "Japanese data suggest that the maxillary canine emerges earlier in Japanese than in Caucasians, on the average".

Dahlberg has presented an interesting composite chart of the eruption of molars and incisors for various population groups.

Determination of Race by Cephalofacial Radiographs [29]

Krogman has summarized the most characteristic racial traits determined by direct examination of the skull. Only some of these can be ascertained radiographically [24].

Williams and Samson have studied bone density radiographically, using an electronic densitometer as a gauge. They have found no correlation with race, sex, or age [30].

They have stated, however, that a correlation exists with relevant body size. Royster and Moriarty have compared the racial variation in size and configuration of the sellaturcica and skull outline between Caucasian and Negro children by means of lateral radiographs of living subjects. They have found a greater variation among Negroes and more homogeneity among Caucasians [30].

Sedwick has investigated racial differences in the maxillary sinuses in Caucasians and Indians. The only difference is that vertical height is less in the Indians. However, he has added that this fact may be correlated with the shorter nose and broader cheeks of this race. The development of roentgenographic cephalometry has permitted recent incursions in the field of racial characteristics [26].

Bjork has compared average composites of Bantus and Swedes. The most important differences reside in the dental protrusion and the configuration of the mandible. He has stressed that individual cases may vary widely from the basic pattern. Other studies along similar lines are those of Lindegard for the Lapps; Takano, Wong, and Cotton for the Nisei and American Chinese and Negro [31]. Sassouni has presented standard tracings for American Negroes, Chinese, and Caucasians [27].

Certain diseases affecting the bones have been found to be confined to certain racial groups. For example, Cooley's anemia is nearly exclusively found in Mediterranean peoples and does not seem to affect the Negro. As its radiographic picture is characteristic, it may permit racial determination. Similar pathologic traits are of potential value in forensic science [30].

Determination of Race by Reconstruction of the Physiognomy

Sassouni has proposed the use of roentgenographic cephalometry as a means of reconstructing missing parts. Certain proportions derived from an archial analysis have permitted an initial attempt. One should be cautious in such reconstruction because of the great variability in facial proportions and types. Investigations of multiple correlations between various parts of the cephalofacial complex may in the future permit a greater accuracy [18].

One of the problems confronted by reconstructive methods of identification is the evaluation of the soft tissues of the face. The previously mentioned studies by means of roentgenographic cephalometry have also provided information on the soft-tissue configuration of the profile [32,33]. The tables of Subtelny are of particular importance, being based on longitudinal records [33].

Sassouni has proposed a new photographic technique, the "physioprint," which permits the registration of the soft tissue in three dimensions. As the physioprint is taken routinely in conjunction with the cephalometric film, superimposition of the two may serve as a basis for the reconstruction of the soft tissue of the face [27].

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