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Age identification in children and youngsters

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Abstract

Identifying the age of living children and youngsters in the forensic medicine practice is done in the case of abandoned little children, mentally retarded or mentally ill persons and of persons who due to various reasons have not been registered in the birth registry and do not possess personal identification documents. Due to increased migration of people and the refugee crisis, it became necessary to determine the age in part of the refugees who do not possess documents, and register themselves as minors.

This paper presents three different cases of age identification: in an abandoned little child, in a young boy perpetrator of offence, and in a refugee girl for the reasons of placing her in a Social Care Centre.

Age identification was done by analysis of an X-ray image of the hand bones, X-ray image of the bones of the whole arm and X-ray image of the whole dentition (ortopantomographs). This analysis revealed data on the development level of the ossification cores of the bones, coalescence of the ossification lines of the long bones and the presence and development stadium of the deciduous and permanent teeth. Obtained data enabled us to determine the age of the examined persons with higher certainty.

The analysis of the development stadium of the ossification cores and ossification lines of the hand bones, and the analysis of the dentition, has provided sufficient data about identification of the age in children and youngsters at the age up to 21-22 years.

Keywords: age identification, ossification cores, teeth, X-ray images

Určovanie veku u detí a mládeže

Abstrakt

Určovanie veku živých osôb sa v súdno-medicínskej praxi vykonáva u opustených, malých detí, mentálne retardovaných a duševne chorých osôb a u osôb, ktoré z rôznych dôvodov neboli zaevidované na matrike a nevlastnia identifikačné doklady. Kvôli zvýšenej migrácii a utečeneckej kríze nastala potreba na určovanie veku časti utečencov, ktorí nevlastnia doklady a prihlasujú sa ako maloletí občania.

V tejto práci sú zaznamenané tri rôzne prípady určovania veku: u opusteného malého dieťaťa, u maloletého chlapca, ktorý spáchal trestný čin a u jednej utečenej dievčiny, pre jej zaopatrenie v centre sociálnej služby.

Určovanie veku bolo vykonané analýzou rtg snímok kostí ruky, zápästia a celého zuboradia. Touto analýzou sa získali údaje o vývoji a osifikácii jadier kostí, zrastaní osifikačných línií dlhých kostí a prítomnosti a vývoji mliečnych a trvalých zubov. Uvedené údaje umožnili určiť vek vyšetrovaných osôb s väčšou istotou.

Analýza vývoja a osifikácie jadier aj osifikačných línií na kostiach ruky ako i analýza zuboradia, dáva dostatočné informácie o identifikácii veku detí aj mladých ľudí vo veku 21-22 rokov.

Kľúčové slová: určovanie veku, osifikácia jadier, zuby, rtg snímky

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Introduction

Identifying of the age of living children and young adults in the forensic medicine practice is most often done in the case of abandoned little children, mentally retarded or mentally ill persons and of persons who due to various reasons have not been registered in the birth registry and do not possess or

have destroyed their personal identification documents (1). During the last decade due to the increased migration of people and refugee crisis it became necessary to determine the age in part of the refugees who do not possess documents, and register themselves as minors (2).

This paper presents three different cases of determining the age: the first case is about determining the age of a small child whose father died and the mother was mentally retarded. The child has been placed in the Social Care Centre, but since it has not been registered in the birth registry, our Institute was requested to perform an expertise in order to determine the age in order to allow for establishing documents such as a birth certificate and a health card.

The second case is about determining the age of a boy without parents' care (alcoholic father, whereabouts of the mother not known), who has not been registered in the birth registry. As a result of his antisocial and delinquent behaviour the boy was placed in an Institution – Department for Care, Education and Upbringing. Age identification was necessary for an additional registration in the birth registry and to determine whether it is a younger or older minor, as a proof in front of the court-of-law to serve in assessing his criminal liability, i.e. to pronounce an appropriate measure or punishment for committed offences (thefts and participation in fights).

The third case is about determining the age of a refugee girl. The girl is staying in our country since March 2016, does not possess any identification documents, and according to her initial statement she was born in August 2000. According to this information she was registered as an unsupervised minor, placed in the Social Care Centre, special guardian assigned to her to protect her rights and interests in the procedure for recognizing her right to asylum. Later, in the end of 2016, when talking to a social worker she stated that she was 20 years old.

The age of the three analysed cases is up to 21-22 years. Age identification in these age groups is best done by analysis of the development of the ossification cores of the bones, of the coalescence of the ossification lines between the epiphyses and diaphysis of the long bones and analysis of the dentition.

Methods

In order to carry out the requested expertise on age identification, an examination was performed of the physical development and X-ray images made of the dentition (panoramic image), X-ray images of the hand-wrist, the elbow and shoulder joints (3). From examination of the physical development, meaning the height, weight and development level of sexual characteristics, no data could be obtained for a more precise age identification (4).

With analysis of the X-ray images of the hand-wrist, elbow and shoulder joints data were obtained on the development level of the ossification cores and ossification lines of the bones, and the analysis of the X-ray images of the dentition provided data on the deciduous and permanent teeth which allowed to determine the age more precisely (3).

Results

Case 1 – male child

The X-ray image of the left hand-wrist (Figure 1): All ossification cores of the bones at the root of the hand are present (os capitatum, os hamatum, os triquetrum, os scaphoideum, os lunatum, os trapezium, os trapezoideum), with the exception of the os pisiforme, which occurs at the age of 8-12 years. There is ossification of the lateral part of the distal epiphysis of os ulnae, which occurs at the age of 7-8 years (5).

The X-ray of the dentition (Figure 2): The first and the second permanent tooth of the upper and lower jaws are present (dens incisivi 1 permanens which occurs at the age of 6-8 years, dens incisivi 2 permanens which occurs at the age of 7-9 years), and the third, fourth and fifth tooth are deciduous teeth (dentes decidui), which are not replaced by permanent teeth. The first molar has started to appear (dens molaris 1) which happens at the age of 6-7 years (6).

The data obtained by analysis of the X-ray images of the dentition and the left hand-wrist indicate that the child of the male sex is at the age of about 8 years.



Fig. 1 Hand-wrist X-rays: male child

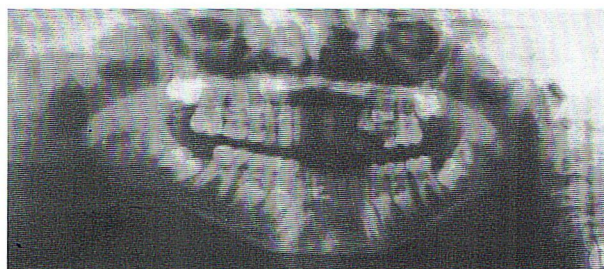


Fig. 2 Ortopantomograph: male child

Case 2 – underage boy

The X-ray image of the hand-wrist (Figure 3): Bones at the root of the hand are fully developed, i.e. ossified, and a discrete line can be spotted between the proximal epiphyses and the diaphysis of the finger bones (phalanges), as well as a discrete line between the distal epiphysis and the diaphysis of the metacarpal bones, and those coalesce fully at the age up to 18 years (according to Lanz (1956) (7). There is a sesamoid bone on the inner side of the thumb next to the joint between the first metacarpal bone and the first phalange of the thumb, which ossifies by the age of 18 years. On the lower joint surface of the two forearm bones, the ossification cores are fully developed, and there is a line between the diaphysis and the distal epiphysis (radius 21-25 years, ulna 20-24 years) (8).

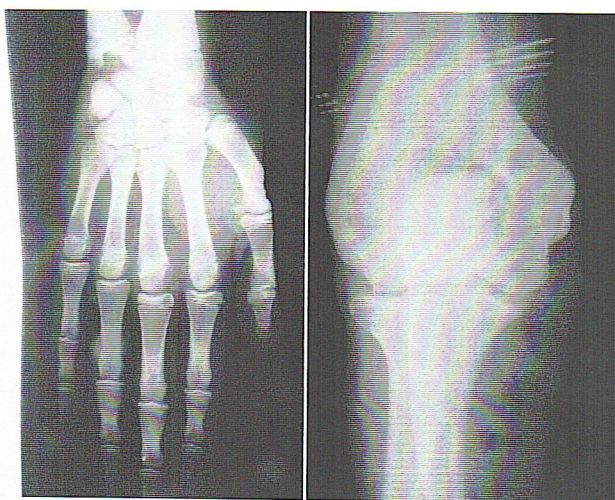


Fig. 3 Hand-wrist X-rays: underage boy (left)

Fig. 4 Elbow joint X-rays: underage boy (right)

The X-ray image of the elbow joint (Figure 4): On the upper joint surface of the two forearm bones, the ossification cores are fully developed. On the os radius between the upper epiphysis and diaphysis there is a discrete line (coalesces at the age of 14-18 years), and the line between the upper epiphyses and the diaphysis of the os ulnae is completely imperceptible (coalesce at the age of 13-17 years). The lower joint surface of the upper arm bone is with fully developed ossification cores, and the line between the distal epiphysis and diaphysis is ossified (13-16 years of age) (9).

The X-ray image of the shoulder joint (Figure 5): Ossification cores of the upper joint surface of the os humerus are fully developed, and the line between the proximal epiphysis and diaphysis is visible (coalesces at the age of 20-25 years). Also a discrete metaphysis line of the acromion of the blade bone can be seen (coalesces at the age of 15-18 years) (9).

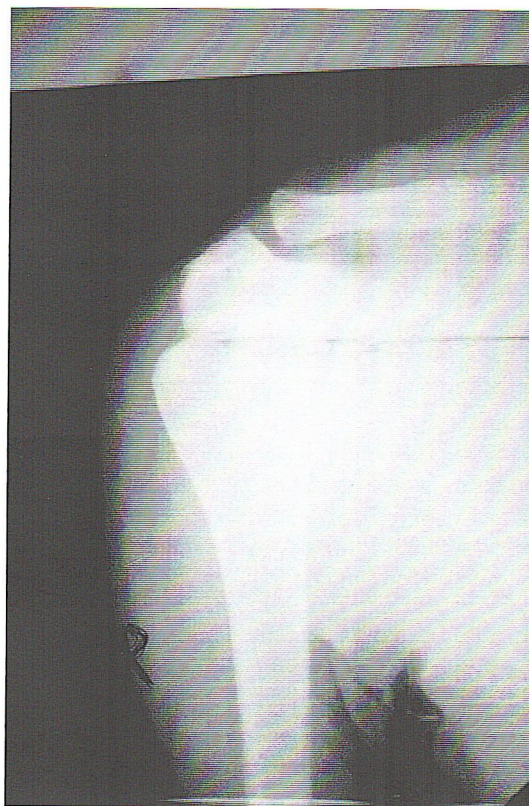


Fig. 5 Shoulder joint X-rays: underage boy

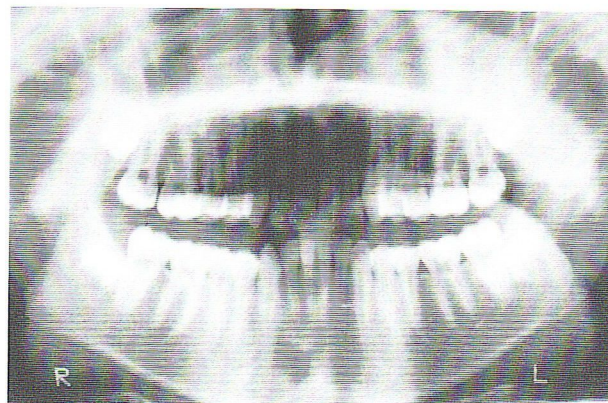


Fig. 6 Ortopantomograph: underage boy

The X-ray image of the dentition (Figure 6): At the panoramic image it can be seen that there are in total 28 teeth, 14 on the lower and 14 on the upper jaw. Only the third molars are not present (the eighths) which according to the image are developed but still have not emerged above the gingiva (they are coming out at the age of 17-21 years) (10,11,12).

Data obtained from the X-ray images of the bones of the upper extremity and the dentition, indicate that the underage boy is at the age of 16-17 years.

Case 3 – young girl

The X-ray image of the right hand-wrist (Figure 7): Bones of the hand are fully ossified, and the line between the proximal epiphysis and diaphysis of the phalanges as well as the line between the distal epiphysis and diaphysis of the metacarpal bones is completely imperceptible (coalesce by the age of 18 years). The lower joint surface of the two forearm bones is with fully developed ossification cores, and the line between the lower epiphysis and diaphysis is imperceptible (coalesces at radius at 21-25 years of age, ulna 20-24 years) (13).

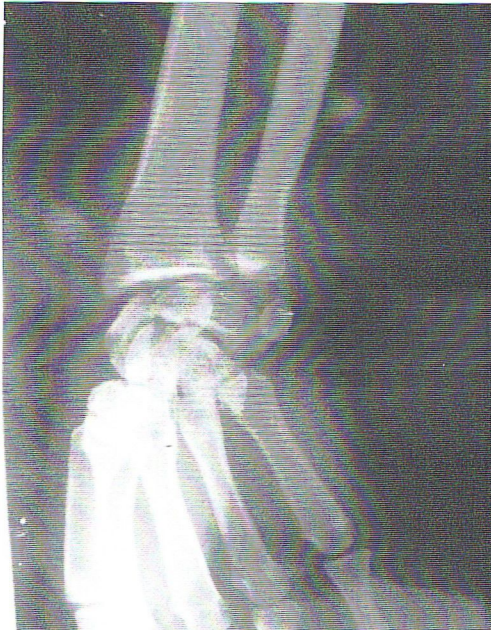


Fig. 7 Hand-wrist X-rays: young girl



Fig. 8 Elbow joint X-rays: young girl

The X-ray image of the elbow joint (Figure 8): The upper joint surface of the two forearm bones is fully ossified, and the line between the proximal epiphyses and diaphysis of the two bones is fully coalesced (radius 14-18, ulna 13-17 years of age). The lower joint surface of the upper arm bone is fully ossified, and the line between the distal epiphysis and diaphysis is fully coalesced (13-16 years of age).

The X-ray image of the shoulder joint (Figure 9): The upper joint surface of the humerua is fully ossified, and the line between the proximal epiphysis and diaphysis is imperceptible except for the outer end where an incomplete coalescence could be spotted (coalesces at the age of 20-25 years) (13).

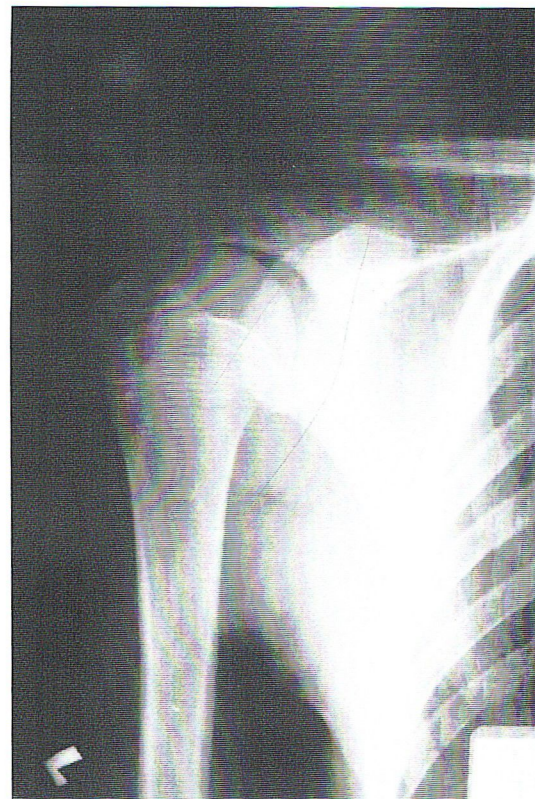


Fig. 9 Shoulder joint X-rays: young girl

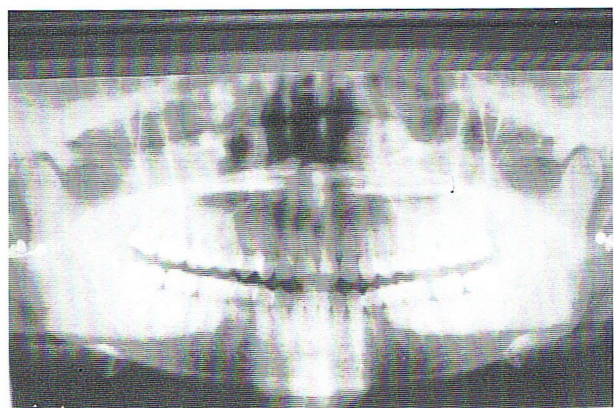


Fig. 10 Ortopantomograph: young girl

The X-ray image of the dentition (Figure 10): There are 32 permanent teeth, eight teeth on both sides of the upper and lower jaws (the eights emerge

above the gingiva at the age of 17-21 years) (10,11,12).

Data obtained from the X-ray images of the bones of upper extremity and the dentition indicate that at the time of the expertise the girl was at the age of 20-21 years.

Conclusion

Growth and development in children and youngsters is strictly individual process which is primarily genetically determined. It is also affected by exogenous factors such as the social, economic, hygiene conditions of living, nutrition, diseases etc.

Regarding the age identification in children we are of the opinion that the X-ray image of the dentition and X-ray image of the hand provide sufficient data, and at the same time it is avoided to expose the children to excessive X-raying. The ossification cores of the hand bones appear at significant periods of time, especially in the first decade of life. The occurrence of the cores is in the range between 1-2 years and provides us with more detailed data about the age. An X-ray image of the dentition allows for analysis of the occurrence and presence of the deciduous and permanent teeth, consequently reducing the "from-to" interval during age identification (14,15).

Regarding age identification of youngsters, the X-ray image of the whole arm allows us to analyze the ossification cores of several bones but also to carry out an analysis of the ossification lines between the epiphyses and diaphyses of the long bones, thus providing more detailed data about the age (14,15).

For evaluation of data we applied the Tables according to Lanz, Greulich and Pyle, Tanner and Whitehouse (7,13). There are of course variations in the development of the skeleton between individuals, sexes and races, yet the sequence of occurrence of the ossification cores and the coalescence of lines between the epiphyses and diaphyses of the bones shows small variations.

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