

An overview of research on forensic age
estimation in living individuals: experiences of
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Bakirkoy Training and Research Hospital, Istanbul



- 57 different medical department
- Emergency service: 1000 patient per day
- Outpatient clinic: 8000 patient per day

Forensic age estimation in living individuals

Department of Forensic Medicine

- performing over 50000 clinical forensic medicine examinations per year
- performing over 1000 forensic age estimations per year


Department of Radiology

- performing over 140000 CT examinations per year
- performing over 145000 MRI examinations per year

Department of Forensic Medicine

Forensic Age Estimation

- Criminal responsibility 57 %
- Civil Rights
 - Marriage 12 %
 - Retirement 2 %
 - Military 4 %
- Refugees 25%

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- *Medial clavicular epiphysis*
 - *Distal tibial epiphysis*
 - *Calcaneal epiphysis*
 - *Proximal tibial epiphysis*
 - *Distal femoral epiphysis*
 - *Iliac crest apophysis*
 - *Spheno-occipital syncondrosis*
 - *Sternal ossification areas*

Medial clavicular epiphysis

Forensic age estimation by the Schmeling method: computed tomography analysis of the medial clavicular epiphysis.

Ekizoglu O, Hocaoglu E, Inci E, Sayin I, Solmaz D, Bilgili MG, Can IO. Int J Legal Med. 2015;129(1):203-10. doi: 10.1007/s00414-014-1121-y.

- Materials and methods
 - 10-35 years
 - 503 patient (362 male and 141 female)
 - CT, Slice thickness 1 mm
 - Schmeling 5 stage system

- Important age thresholds
 - Stage 2: 14 years for male
 - Stage 3: 16 years for both sex
 - Stage 4: 20 years for both sex
 - Stage 5: 25 years for both sex

Intraobserver
kappa: 0.768

Interobserver
kappa: 0.826

Medial clavicular epiphysis

Estimation of forensic age using substages of ossification of the medial clavicle in living individuals.

Ekizoglu O, Hocaoglu E, Inci E, Can IO, Aksoy S, Sayin I.

Int J Legal Med. 2015;129(6):1259-64. doi: 10.1007/s00414-015-1234-y.

- Materials and methods
 - 13-28 years old
 - 193 patient (129 male and 64 female)
 - CT, Slice thickness 1 mm
 - Kellinghaus et al. substage system



- Important ages

- Stage 3c: 19 years for both sex

Intraobserver
kappa: 0.916

Interobserver
kappa: 0.868

Distal tibial epiphysis

Magnetic resonance imaging of distal tibia and calcaneus for forensic age estimation in living individuals.

Ekizoglu O, Hocaoglu E, Can IO, Inci E, Aksoy S, Bilgili MG.

Int J Legal Med. 2015;129(4):825-31. doi: 10.1007/s00414-015-1187-1.

- Materials and methods
 - 8-25 years
 - 167 patient (97 male and 70 female)
 - 1.5-T MRI, Slice thickness 2-4mm
 - Saint-Martin et al. 3 stage system

Intraobserver
kappa: 0.883

Interobserver
kappa: 0.834

- Important ages
 - Stage 2: 14 years for males and 12 years for females
 - Stage 3: 15 years for males and 14 years for females

Calcaneal epiphysis

Magnetic resonance imaging of distal tibia and calcaneus for forensic age estimation in living individuals.

Ekizoglu O, Hocaoglu E, Can IO, Inci E, Aksoy S, Bilgili MG.

Int J Legal Med. 2015;129(4):825-31. doi: 10.1007/s00414-015-1187-1.

- **Material and method**
 - 8-25 years
 - 167 patient (97 male and 70 female)
 - 1.5-T MRI, Slice thickness 2-4mm
 - Saint-Martin et al. 3 stage system

Intraobserver
kappa: 0.811

Interobserver
kappa: 0.802

- Important ages
 - Stage 2: 14 years for males
 - Stage 3: 16 years for males and 12 years for females

Proximal tibial epiphysis

Forensic age estimation via 3-T magnetic resonance imaging of ossification of the proximal tibial and distal femoral epiphyses: Use of a T2-weighted fast spin-echo technique.

Ekizoglu O, Hocaoglu E, Inci E, Can IO, Aksoy S, Kazimoglu C.

Forensic Sci Int. 2016;260:102.e1-7. doi: 10.1016/j.forsciint.2015.12.006.

- Materials and methods
 - 10-30 years
 - 503 patient (305 male and 198 female)
 - 3-T MRI, Slice thickness 2-4mm, T2 weighted
 - Dedouit et al. 5 stage system



- Important ages

- Stage 3: 14 years for males
- Stage 4: 17 years for males and 15 years for females
- Stage 5: 18 years for males and 16 years for females

Intraobserver
kappa: 0.919

Interobserver
kappa: 0.836

Distal femoral epiphysis

Forensic age estimation via 3-T magnetic resonance imaging of ossification of the proximal tibial and distal femoral epiphyses: Use of a T2-weighted fast spin-echo technique.

Ekizoglu O, Hocaoglu E, Inci E, Can IO, Aksoy S, Kazimoglu C.

Forensic Sci Int. 2016;260:102.e1-7. doi: 10.1016/j.forsciint.2015.12.006.

- Materials and methods
 - 10-30 years
 - 503 patient (305 male and 198 female)
 - 3-T MRI, Slice thickness 2-4mm, T2 weighted
 - Dedouit et al. 5 stage system

- Important ages

- Stage 2: 14 years for males
- Stage 3: 16 years for males and 14 years for females
- Stage 4: 17 years for males and 16 years for females
- Stage 5: 22 years for males and 21 years for females

Intraobserver
kappa: 0.961

Interobserver
kappa: 0.885

Iliac crest apophysis

Computed tomography evaluation of the iliac crest apophysis: age estimation in living individuals.

Ekizoglu O, Inci E, Erdil I, Hocaoglu E, Bilgili MG, Kazimoglu C, Reisoglu A, Can IO.

Int J Legal Med. 2016 Feb 25

- **Materials and methods**
 - 10-29 years old
 - 380 patient (193 male and 187 female)
 - CT, Slice thickness 1.5 mm
 - Kreitner et al. 4 stage system



- Important ages

- Stage 2: 12 years for both sex

- Stage 3: 14 years for both sex

- Stage 4: 17 years for both sex

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Intraobserver
kappa: 0.961

Interobserver
kappa: 0.885

Spheno-occipital synchondrosis

Forensic age estimation by spheno-occipital synchondrosis fusion degree: computed tomography analysis.

Can IO, Ekizoglu O, Hocaoglu E, Inci E, Sayin I, Kaya KH.

*J Craniofac Surg. 2014;25(4):1212-6. doi:
10.1097/SCS.0000000000000847.*

- Materials and methods
 - 10-25 years
 - 638 patient (399 male and 139 female)
 - 1mm CT images
 - Bassed et al. 5 stage system

Spheno-occipital synchondrosis

Spheno-occipital synchondrosis fusion degree as a method to estimate age: a preliminary, magnetic resonance imaging study.

*Ekizoglu O, Hocaoglu E, Can IO, Inci E, Aksoy S, Sayin I
Australian Journal of Forensic Sciences, 2016;48(2):1-12.
DOI: 10.1080/00450618.2015.1042047*

- Materials and methods
 - 7-21 years old
 - 1078 patient (455 male and 623 female)
 - 1.5-T MRI, Slice thickness 2-4mm
 - Bassed et al. 5 stage system



- Important ages

- Stage 4: 13 years old both sex
- Stage 5: 14 years old male /
12 years old female

Intraobserver
kappa: 0.954

Interobserver
kappa: 0.907

Manubrio-mesosternal ossifications

Analysis of the manubrio-mesosternal and mesosterno-xiphisternal junctions to estimate age: a preliminary CT study. Medicine. Accepted paper.

- **Materials and methods**
 - 30-60 years
 - 509 patient (275 male and 234 female)
 - CT, Slice thickness 1 mm
 - 3 stage system (no fusion, partial fusion, complete fusion)



- Important ages

- Stage 1-3: 30-60 years for both sex

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Intraobserver
kappa: 0.983

Interobserver
kappa: 0.934

Mesosterno-xiphisternal ossifications

Analysis of the manubrio-mesosternal and mesosterno-xiphisternal junctions to estimate age: a preliminary CT study. Medicine. Accepted paper.

- **Material and method**
 - 30-60 years old
 - 509 patient (275 male and 234 female)
 - CT, Slice thickness 1 mm
 - 2 stage system (no fusion, complete fusion)

- Important ages

- Stage 1:

30-53 years for males

30-52 years for females

- Stage 2:

30-60 years old for both sex

Intraobserver
kappa: 0.983

Interobserver
kappa: 0.934

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Male

Spheno-occipital
synchondrosis, MRI
12 and 14 years

Medial clavicular epiphysis
using substages, CT
14, 16, 18 and 19 years

Proximal tibial epiphysis,
MRI
14 and 16 years

Distal tibial epiphysis, MRI
14 years

Medial clavicular epiphysis
using Schmelting method,
CT
14, 16, 20 and 25 years

Iliac crest apophysis, CT
12 and 14 years

Distal femoral epiphysis,
MRI
14, 16, and 22 years

Calcaneal epiphysis, MRI
14 and 16 years

Female

Spheno-occipital
synchondrosis, MRI
12 and 14 years

Medial clavicular epiphysis
using substages, CT
16 and 19 years

Proximal tibial epiphysis,
MRI
16 years

Distal tibial epiphysis, MRI
12 and 14 years

Medial clavicular epiphysis
using Schmelting method,
CT
16, 20 and 25 years

Iliac crest apophysis, CT
12 and 14 years

Distal femoral epiphysis ,
MRI
14, 16, and 21 years

Calcaneal epiphysis, MRI
12 years