

Supplementary Material

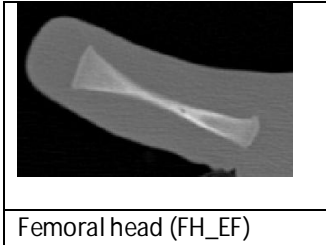
List and definitions of the epiphyses scored

Bone	Epiphyses	KSCollect abbreviation	Scoring system
Humerus	Humeral Head Ossification	HH_Oss	2-stage scoring system
	Humeral Greater Tubercle Ossification	HGT_Oss	
	Humeral Lesser Tubercle Ossification	HLT_Oss	
	Humeral Proximal Epiphyseal Fusion (PE=fused HH, GT and LT). If HPE not fused, score 0 If HPE fused but unfused to diaphysis, score 1	HPE_EF = exists only if HH_Oss + HGT_Oss + HLT_Oss are fused together (stage 0 if absent or all present but unfused)	7-stage scoring system
	Capitulum Ossification	HC_Oss	2-stage scoring system
	Trochlea Ossification	HT_Oss	
	Lateral Epicondyle Ossification	HLE_Oss	
	Composite Epiphysis 1 (fusion of capitulum and trochlea) Epiphyseal Fusion	HCE1_EF = H_C_Oss + H_T_Oss	2-stage scoring system
	Composite Epiphysis 2 (fusion of CE1 and lateral epicondyle) Epiphyseal Fusion	HCE2_EF = HCE1 + HLE_Oss	
	Medial Epicondyle Epiphyseal Fusion	HME_EF	7-stage scoring system
	Distal Epiphysis Epiphyseal Fusion (Fusion to the diaphysis)	HDE_EF = HME_EF + HCE_2_EF Exists only if these elements are present (stage 0 is absent or present and all unfused)	7-stage scoring system
	Radius	Proximal Epiphysis Fusion	RPE_EF
Distal Epiphysis Fusion		RDE_EF	
Ulna	Proximal Epiphysis Fusion	UPE_EF	7-stage scoring system
	Distal Epiphysis Fusion	UDE_EF	
Femur	Femoral Head Epiphyseal Fusion	FH_EF	7-stage scoring system
	Femoral Greater Trochanter Epiphyseal Fusion	FGT_EF	
	Femoral Lesser Trochanter Epiphyseal Fusion	FLT_EF	
	Femoral Distal Epiphysis Epiphyseal Fusion	FDE_EF	
Tibia	Tibial Proximal Epiphysis Epiphyseal Fusion	TPE_EF	7-stage scoring system
	Tibial Distal Epiphysis Epiphyseal Fusion	TDE_EF	
Fibula	Fibular Proximal Epiphysis Epiphyseal Fusion	FBPE_EF	7-stage scoring system
	Fibular Distal Epiphysis Epiphyseal Fusion	FBDE_EF	
Pelvis	Ischio-Pubic Ramus Epiphyseal Fusion	ISPR_EF	3-stage scoring system
	Ischio-Iliac Epiphyseal Fusion	ILIS_EF	
Calcaneus	Calcaneal Tuberosity Epiphyseal Fusion	CT_EF	7-stage scoring system
Patella	Patella Ossification	PC_Oss	2-stage scoring system
Carpals	Number of carpals present	CC_Oss	0-8
Tarsals	Number of tarsals present	TC_Oss	0-7

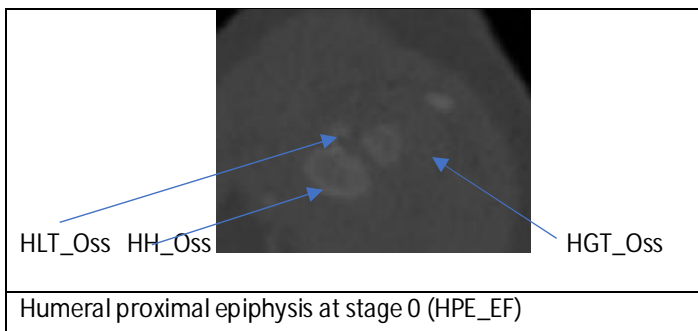
Epiphyseal fusion staging systems and the corresponding epiphyses

- *Seven-stage scoring system: long bone epiphyses, calcaneal tuberosity*

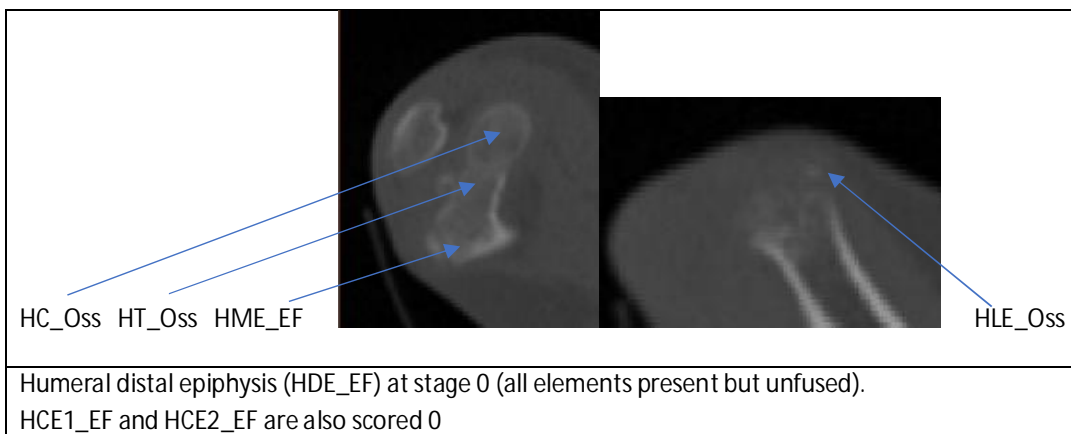
0) "absent": the epiphysis has not ossified (or appeared);



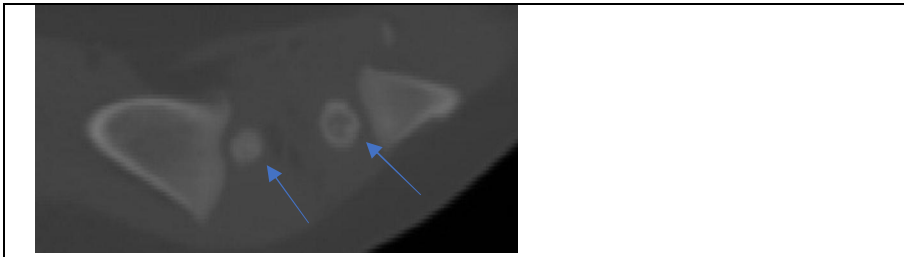
NB: For HPE_EF, stage is 0 if all three elements (Head, Greater Tubercle and Lesser Tubercle) are not fused together. The image below shows all three elements present but not all fused together (HH is only fused to HLT). Hence, assigned stage is 0.



For HDE_EF, stage is 0 if the elements of HCE2_EF (capitulum, trochlea, lateral epicondyle) and HME_EF are not all present. If they are present but unfused, stage is 1.

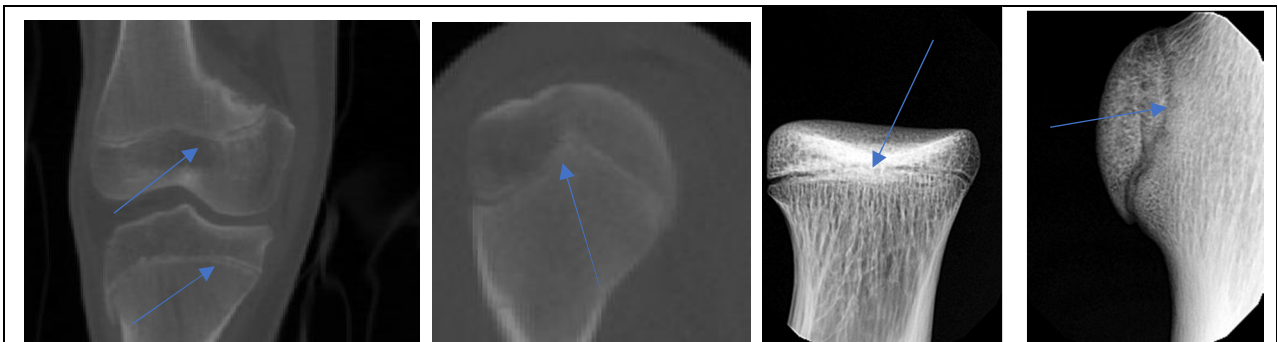


1) "present": the epiphysis has appeared but is characterized by the lack of any bony attachments;



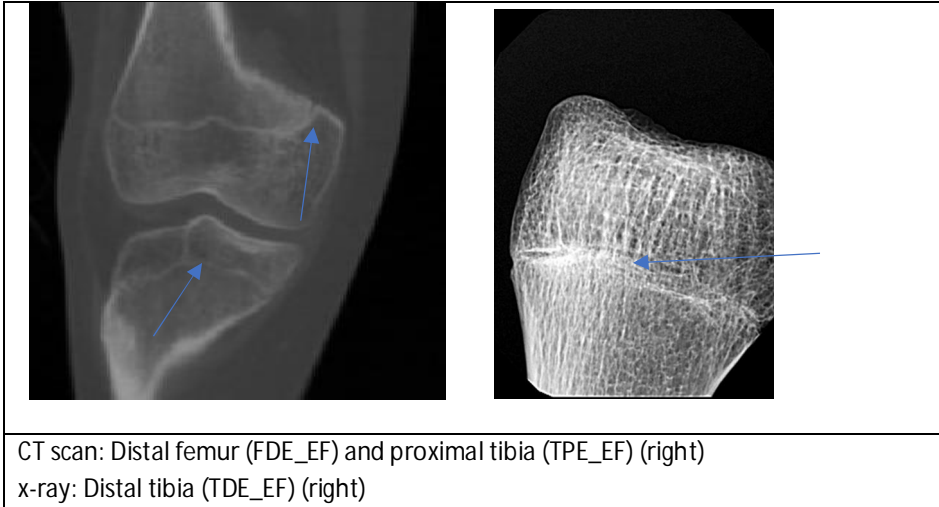
CT scan: Distal femoral epiphysis (FDE_EF) and proximal tibial epiphysis (TPE_EF)

2) "active union" requires metaphyseal trabeculae to cross the epiphyseal growth plate to initiate bone fusion with the epiphysis (with bony bridging equal or slightly less than half the length of the epiphyseal growth plate evident, some gaps maintained throughout). A thick white line or "halo" and some bony bridging can be seen with some parts of the epiphyseal growth plate disconnected from the diaphyseal growth plate;

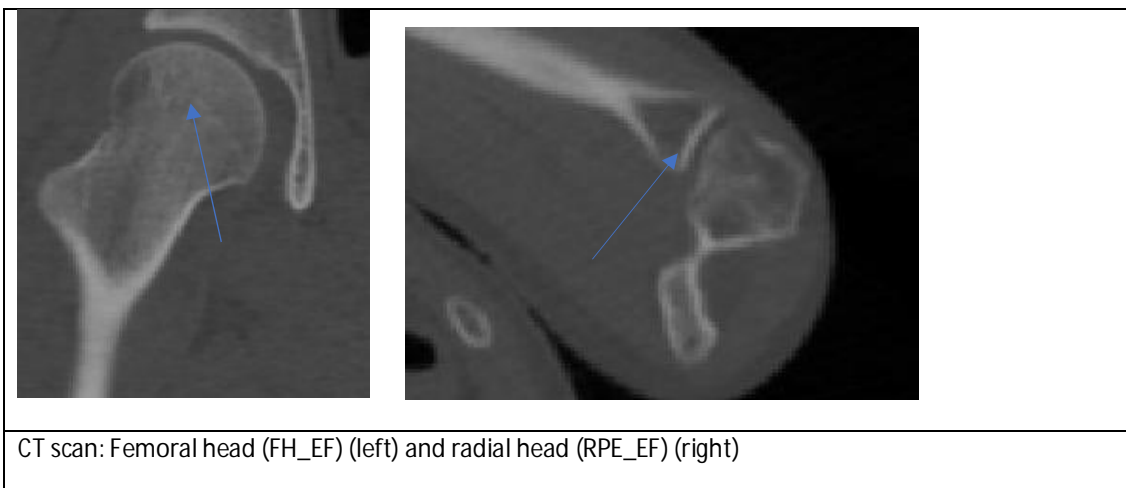


CT scan: Distal femur (FDE_EF) and proximal tibia (TPE_EF) (left) Proximal humerus (HPE_EF) (center left)
x-ray: Proximal radius (RPE_EF) (center right) Lesser Trochanter (FLT_EF) (right)

3) "advanced union" is characterized by bony bridging greater than 75% of the length of the growth plate, with no or minor radiolucent gaps retained throughout;

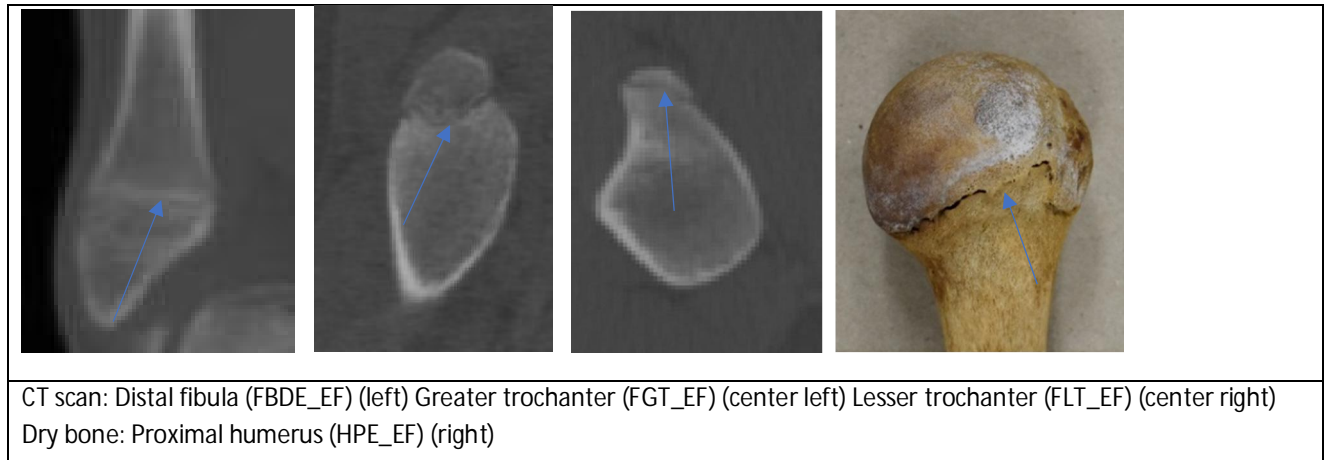


4) "complete union", demonstrated by homogenous radiodensity and/or invisible scar.

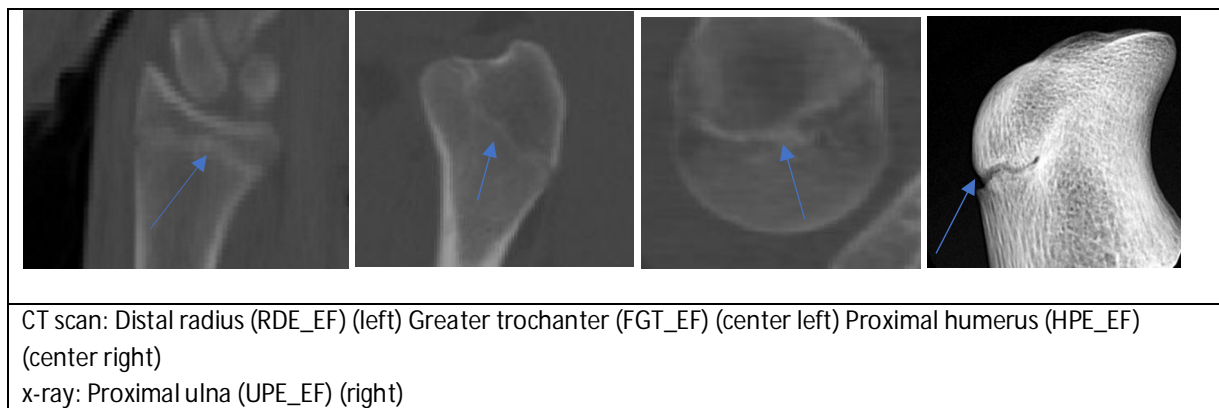


Note: Another two stages, termed "Early active union" and "Active/advanced union," can be scored when it is clear that an epiphysis is undergoing fusion (and is therefore in Stage 1 or 2, or 2 or 3 respectively), but a determination of the degree of fusion cannot be reliably made. Stages are transformed numerically into "1/2" and "2/3", respectively.

1/2) "early active union": EF is less than 25% and scattered throughout the growth plate

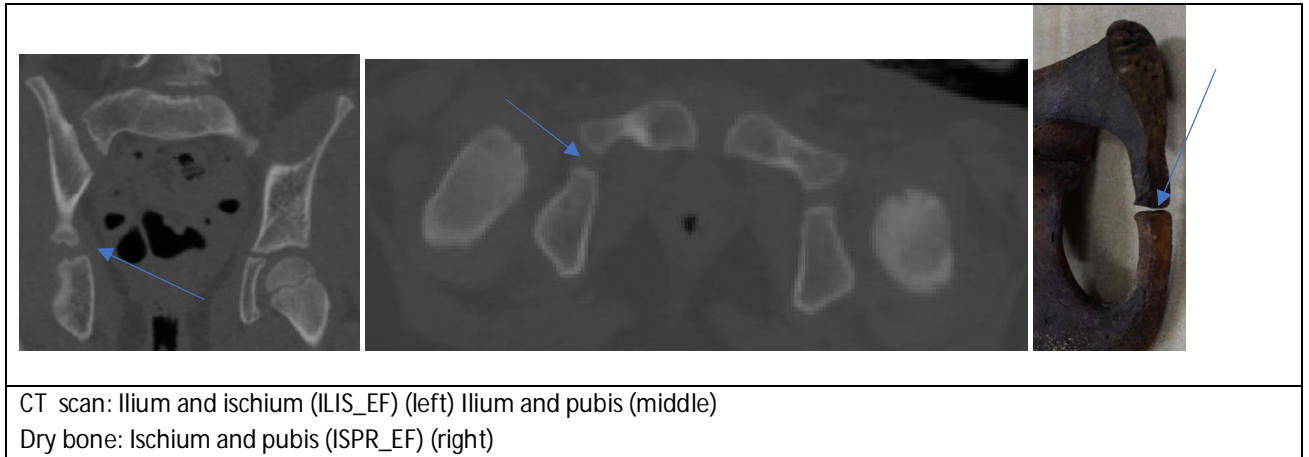


2/3) "active/advanced union": EF is between 50% and 75% and we can't choose between 2 or 3

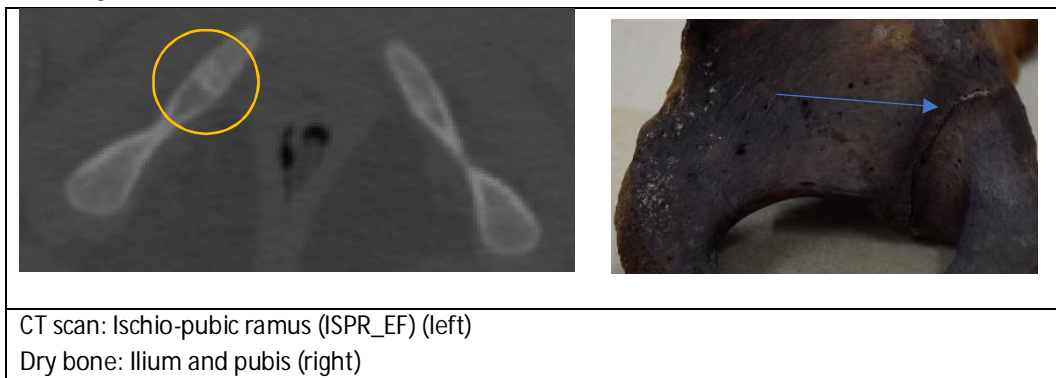


- *Three-stage scoring system: pelvic epiphyses*

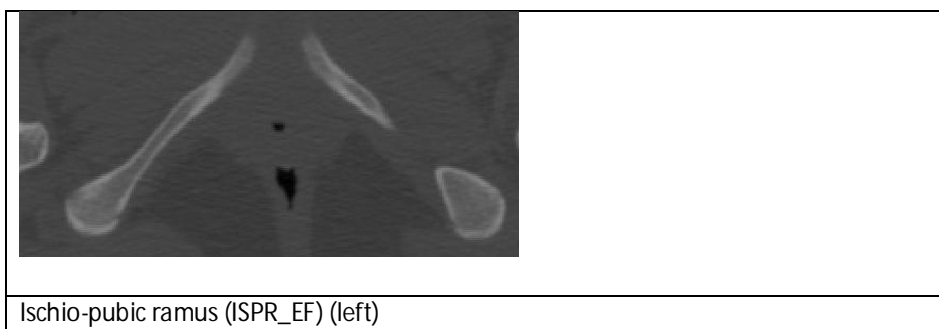
0: Unfused



1: Fusing



2: Fused



- *Two-stage scoring system (ossification): elements of the humeral head, distal humerus, patella*

0: Absent



Capitulum (HC_Oss)

1: Present



Capitulum (HC_Oss)

Dental development staging system used to score permanent teeth (from AlQahtani et al. 2010)

Stage	Description
1	Initial cusp formation
2	Coalescence of cusps
3	Cusp outline complete
4	Crown half completed with dentine formation
5	Crown three quarters completed
6	Crown completed with defined pulp roof
7	Initial root formation with diverge edges
8	Root length less than crown length
9	Root length equals crown length
10	Three quarters of root length developed with diverge ends
11	Root length completed with parallel ends
12	Apex closed (root ends converge) with wide periodontal ligament
13	Apex closed with normal periodontal ligament width

Mean Cohen's Kappa and Kendall's W values for intra- and inter-observer agreement of epiphyseal fusion stages scored on CT scans

Variable	Cohen's kappa				Kendall's W
	MKS-MKS	MKS-LKC	MKS-SJC**	LKC-SJC**	MKS-LKC-SJC
FH_EF	1.000	0.832	0.833	0.916	0.860
FGT_EF	1.000	0.820	0.859	0.868	0.795
FLT_EF	1.000	1	0.781	0.781	0.772
FDE_EF	0.853	0.787	0.643	0.899	0.642
TPE_EF	1.000	1	0.805	0.805	0.693
TDE_EF	0.853	0.915	0.855	0.855	0.834
FBPE_EF	1.000	1	0.937	0.937	0.940
FBDE_EF	1.000	0.835	0.935	0.871	0.887
HH_Oss	1.000	1	1	1	1
HGT_Oss	1.000	0.798	0.8	0.9	0.865
HLT_Oss	0.800	0.900	0.800	0.800	0.866
HPE_EF	0.741	1	0.557	0.557	0.693
HC_Oss	1.000	1	1	1	1
HT_Oss	0.800	0.733	0.737	0.875	0.822
HLE_Oss	0.783	1	0.737	0.737	0.814
HCE1_EF	0.825	0.857	0.545	0.652	0.561
HCE2_EF	0.909	0.733	0.429	0.467	0.501
HDE_EF	0.875	0.747	0.756	0.770	0.593
HME_EF	0.906	1	0.787	0.787	0.735
RPE_EF	1.000	0.729	0.775	0.889	0.749
RDE_EF	1.000	0.918	0.767	0.869	0.814
UPE_EF	1.000	0.856	0.785	0.700	0.643
UDE_EF	1.000	0.890	0.747	0.884	0.786
CT_EF	1.000	0.876	0.879	0.949	0.836
CC_Oss	1.000	0.869	0.920	0.878	0.736
TC_Oss	1.000	0.922	0.853	0.885	0.800
ISPR_EF	0.884	0.875	1	0.925	0.917
ILIS_EF	1.000	1	0.894	0.894	0.886
PC_Oss	1.000	0.989	1	0.898	0.930
Average	0.939	0.892	0.807	0.836	0.792

Mean Cohen's kappa values for consistency of epiphyseal fusion stages scored on CT scan and scout images

Variable	MKS	LKC
FH_EF	0.804	0.882
FGT_EF	0.868	0.880
FLT_EF	0.714	0.610
FDE_EF	0.787	0.722
TPE_EF	0.702	0.779
TDE_EF	0.934	0.934
FBPE_EF	0.670	1
FBDE_EF	0.931	0.933
HH_Oss	0.643	0.643
HGT_Oss	0.800	0.900
HLT_Oss	0.700	0.900
HPE_EF	0.794	0.664
HC_Oss	0.675	0.483
HT_Oss	1	0.646
HLE_Oss	1	0.821
HCE1_EF	1	0.380
HCE2_EF	1	0.301
HDE_EF	0.652	0.663
HME_EF	0.634	0.758
RPE_EF	0.546	0.591
RDE_EF	0.871	0.801
UPE_EF	0.448	0.727
UDE_EF	0.429	0.724
CT_EF	0.592	0.505
CC_Oss	0.717	0.622
TC_Oss	0.547	0.769
ISPR_EF	0.601	0.733
ILIS_EF	0.667	0.677
PC_Oss	0.667	1
Average	0.738	0.726

Mean Cohen's kappa and Kendall's W values for intra- and inter-observer agreement of dental development stages scored on CT scans

Variable	Cohen's kappa				Kendall's W
	CNH-CNH	LKC-KES	CNH-KES	LKC-CNH	CNH-LKC-KES
max_M1_L	0.816	0.687	0.796	0.835	0.952
max_M1_R	0.816	0.687	0.796	0.835	0.952
max_M2_L	0.753	0.848	0.848	1.000	0.913
max_M2_R	0.753	0.848	0.848	1.000	0.913
max_M3_L	0.767	1.000	1.000	1.000	1.000
max_M3_R	0.793	1.000	1.000	1.000	1.000
max_PM1_L	0.761	0.706	0.741	0.835	0.962
max_PM1_R	0.761	0.842	0.741	0.682	0.929
max_PM2_L	0.815	0.860	0.754	0.800	0.913
max_PM2_R	0.823	0.829	0.754	0.829	0.913
max_C_L	0.781	0.837	0.854	0.788	0.948
max_C_R	0.781	0.791	0.854	0.788	0.960
max_I1_L	0.638	0.770	0.750	0.689	0.919
max_I1_R	0.638	0.770	0.750	0.689	0.919
max_I2_L	0.585	0.814	0.774	0.720	0.907
max_I2_R	0.585	0.870	0.821	0.720	0.919
man_M1_L	0.796	0.797	0.851	0.745	0.962
man_M1_R	0.767	0.797	0.851	0.745	0.962
man_M2_L	0.898	0.873	1.000	0.873	0.929
man_M2_R	0.898	0.873	1.000	0.873	0.929
man_M3_L	0.792	1.000	0.632	0.632	1
man_M3_R	0.792	1.000	0.632	0.632	1
man_PM1_L	0.829	0.777	0.774	0.944	0.982
man_PM1_R	0.880	0.892	0.840	0.811	0.982
man_PM2_L	0.867	0.875	0.715	0.715	0.919
man_PM2_R	0.867	0.875	0.788	0.715	0.919
man_C_L	0.764	0.775	0.721	0.614	0.943
man_C_R	0.696	0.775	0.721	0.614	0.943
man_I1_L	0.627	0.684	0.735	0.650	0.895
man_I1_R	0.627	0.684	0.735	0.650	0.895
man_I2_L	0.635	0.684	0.721	0.650	0.895
man_I2_R	0.635	0.720	0.701	0.650	0.875
Average	0.757	0.820	0.797	0.773	0.900