Supporting Information Table 1. Visual scoring performed by two independent observers (intra- and inter-observer tests). SSc: Statistical Scoring; VS1T1: Visual scoring Observer 1 Test 1; VS1T2: Visual scoring Observer 1 Test 2; VS2: Visual scoring Observer 2. In some cases, the observers gave an intermediate rating (0_1 meaning a category between ASUDAS references 0 & 1).

Specimen	Origin	VS1T1	VS1T2	VS2
SA1	South African	1	1	1
SA2	South African	1	1	1
SA3	South African	0_1	0_1	0_1
SA4	South African	2	2	2
SA5	South African	1	1	1
SA6	South African	1	1	1
SA7	South African	0	0	0
SA8	South African	0	0	0
SA9	South African	1	1	1
SA10	South African	1	1	1
SA11	South African	1	1	1
SA12	South African	1	1	1
SA13	South African	1	1	1
SA14	South African	1_2	2	1_2
SA15	South African	0	1	0
SA16	South African	2	2	2
SA17	South African	2	2	2
SA18	South African	0	0	0
SA19	South African	0	0	0
SA20	South African	1	1	1
SA21	South African	1	1	1
SA22	South African	1	1	1
SA23	South African	1	1	1
SA24	South African	1	1	1
SA25	South African	1	1	1
SA26	South African	1	1	1
SA27	South African	0	0	0
SA28	South African	0	0	0
SA29	South African	1	1	1
SA30	South African	2	2	2
CH1	Chinese	3	3	3_4
CH2	Chinese	3	3	3
CH3	Chinese	4	4	4
CH4	Chinese	5	5_6	5
CH5	Chinese	5_6	6	5_6
CH6	Chinese	4	4	4

CH7	Chinese	3	3	3
CH8	Chinese	4_5	4_5	4_5
CH9	Chinese	2	2	2_3
CH10	Chinese	3	3	3
CH11	Chinese	3	3	3
CH12	Chinese	3	3	3
CH13	Chinese	4_5	5	5
FM1	French medieval	1	1	1
FM2	French medieval	1	1	1
FM3	French medieval	1	1	1
FM4	French medieval	1_2	2	2
FM5	French medieval	2	2	2
FM6	French medieval	0	0	0
FM7	French medieval	0	0	0
FM8	French medieval	0_1	0_1	0_1
FM9	French medieval	0	0	0
FM10	French medieval	2	2	2
FM11	French medieval	1	1	1
FM12	French medieval	2	2	2
FM13	French medieval	1	1	1
FM14	French medieval	1	1	1
FM15	French medieval	1	1	1
FM16	French medieval	0	0	0
FM17	French medieval	0	0	0
FM18	French medieval	0	0	0
FM19	French medieval	0_1	0_1	0_1
FM20	French medieval	0	0_1	0
FM21	French medieval	0_1	0_1	0_1
FM22	French medieval	1	1	1
FM23	French medieval	1	1	1
FM24	French medieval	1	1	1
FM25	French medieval	0_1	0_1	0_1
FM26	French medieval	1	1	1
FM27	French medieval	0_1	0_1	0_1
FM28	French medieval	0	0	0
FM29	French medieval	1	1_2	1
FM30	French medieval	0	0	0
FM31	French medieval	0	0	0
FC1	French contemporary	1_2	1	1_2
FC2	French contemporary	1	1	1
FC3	French contemporary	1	1	1
FC4	French contemporary	2	1	1_2
FC5	French contemporary	1	1	1
FC6	French contemporary	2	2	2

FC7	French contemporary	1	1	1
FC8	French contemporary	2	2	1
FC9	French contemporary	1	1	1
FC10	French contemporary	2	2	2
FC11	French contemporary	3	3	2
FC12	French contemporary	0_1	0_1	1
FC13	French contemporary	1	1	1

Supporting Information Table 2. Definition of UI1 shoveling grades (Turner et al. 1991; Scott and Irish, 2017; Scott et al., 2018).

grade	degree of shoveling	definition
0	absence	Lingual surface is essentially flat although it may show very slight marginal ridge expression.
1	trace	Marginal ridges can be discerned, but expression is slight, with mesial marginal ridge not extending to the basal eminence.
2	low-moderate	Ridges more pronounced, with mesial marginal ridge extending further down on basal eminence.
3	high-moderate	Ridges more pronounced, almost coalescing at basal eminence.
4	low-pronounced	Well-developed ridges that converge at basal eminence.
5	medium-pronounced	More pronounced marginal ridges meeting at basal eminence.
6	high-pronounced	Pronounced ridges that meet at basal eminence, almost folding around on themselves.
7	extreme-pronounced	A rare expression, so much so that a good example for the plaque was never found.

Supporting Information Table 3. Correlations between various measurements obtained from the coordinates of the 7 ASUDAS reference casts. The ASUDAS category values were also compared against these metrics.

		ASUDAS	direct metrics		Procrustes PC		non-Procrustes PC	
		category value	maximum depth	hollow area	PC1	PC2	PC1	PC2
ASUDAS	category value	-	0.98	0.95	0.98	-0.50	0.97	-0.69
direct metrics	maximum depth	0.98	-	0.98	0.99	-0.44	0.99	-0.65
	hollow area	0.95	0.98	-	0.95	-0.25	0.99	-0.49
Procrustes PC	PC1	0.98	0.99	0.95	-	-0.53	0.98	-0.73
	PC2	-0.50	-0.44	-0.25	-0.53	-	-0.35	0.96
non-Procrustes PC	PC1	0.97	0.99	0.99	0.98	-0.35	-	-0.57
	PC2	-0.69	-0.65	-0.49	-0.73	0.96	-0.57	-

Supporting Information Table 4. Correlations between various measurements obtained from the coordinates of all French samples (both contemporary and medieval). Maximum depth and hollow area are the directly measured metrics based on the non-Procrustes alignment method. Principal components were obtained from both Procrustes and non-Procrustes methods. Only PC1 is presented here for simplicity. Shades of color represent the degree of correlation, with darker green corresponding to the highest degrees and white to the lowest degree.

	maximum depth	hollow area	Procrustes PC1 (French only)	non-Procrustes PC1 (French only)
maximum depth	-	0.96	0.93	0.97
hollow area	0.96	-	0.85	1.00
Procrustes PC1 (French only)	0.93	0.85	-	0.89
non-Procrustes PC1 (French only)	0.97	1.00	0.89	-

Supporting Information Table 5. Correlations of rater-assigned ASUDAS categories with various measurements obtained from the coordinates of all French samples.

	VS1 T1	VS1 T2	VS2
maximum depth	0.73	0.76	0.71
hollow area	0.62	0.69	0.63
Procrustes PC1 (French only)	0.71	0.72	0.65
non-Procrustes PC1 (French only)	0.65	0.71	0.65

Supporting Information Figure 1. Principal Component loadings represented as PC shape changes. Results are shown here for non-Procrustes PCs; the plots for Procrustes PCs are very similar. The axes are same as in Figure 2. The black line, showing the shape for ASUDAS reference cast category 3, indicates the baseline in all figures. The thick colored curve in each figure represents a +1 unit shift towards the direction of the PC from the baseline. Thin dotted lines join the coordinate of each of the 100 points before and after the shift, thus representing the amount and direction of shift for each point.