SUPPLEMENTARY ONLINE MATERIAL FOR

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A morphometric approach to the specific separation of the humeri and femora of *Dicraeosaurus* from the Late Jurassic of Tendaguru/Tanzania

Supplementary Online Material

Statistic results for Discriminant Factor Analysis.

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Table 1. Test of equality of group means for the humeri. Abbreviations: df 1, df 2, degree of freedom; F, F-distribution for univariate ANOVA. X, Y, Uniform X and Uniform Y are partial warps coordinates (variables). Variables with a significance value lower than 0.01 are marked in greyscale and are used to differentiate between groups.

Partial warps	Wilks' Lambda	F	df 1	df 2	Significance
X1	0.900	1.506	2	27	0.240
Y1	0.865	2.101	2	27	0.142
X2	0.803	3.308	2	27	0.052
Y2	0.973	0.377	2	27	0.690
X3	0.679	6.387	2	27	0.006
Y3	0.908	1.363	2	27	0.273
X4	0.878	1.881	2	27	0.172
Y4	0.478	14.762	2	27	0.000
X5	0.944	0.802	2	27	0.459
Y5	0.795	3.489	2	27	0.045
X6	0.824	2.890	2	27	0.073
Y6	0.920	1.166	2	27	0.327
X7	0.979	0.287	2	27	0.753
Y7	0.997	0.044	2	27	0.957
X8	0.560	10.595	2	27	0.000
Y8	0.810	3.171	2	27	0.058
Uniform X	0.209	51.214	2	27	0.000
Uniform Y	0.994	0.087	2	27	0.917

Table 2. Box's test of equality of the covariance matrices across the groups of humeri. The determinant's ranks and natural logarithms (ln) are taken from the group covariance matrices. Abbreviations: df 1, df 2, degree of freedom; F-approximation, F-test approximation.

Test results		Log determinants		
Box's M-test	34.030	Segment	Rank	Log determinant
F-approximation	1.171	1	4	222.738
df 1	20	2	4	222.126
df 2	586.650	3	4	218.905
significance	0.273	common within groups	4	223.181

Table 3. Summary of canonical discriminant functions used for the humeri. Variance: refers to the variance explained by the function.

Function	Eigenvalues	Variance (%)	Cumulative (%)	Canonical correlation
1	4.933	95.0	95.0	0.912
2	0.259	5.0	100	0.454

Table 4. Wilk's Lambda and chi² test for the humeri, for the discriminatory capabilities of the discriminant functions. c², chi2 value; df, degree of freedom for each function.

Test of functions	Wilks' Lambda	χ^2	df	Significance
1 to 2	0.134	51.284	8	0.000
2	0.794	5.882	3	0.117

Table 5. Summation table for the classification of the cases, in numbers and percentage: 1, 80.0% of original grouped cases correctly classified; 2, 73.3% of cross-validated grouped cases correctly classified; 3, Cross validation is done for only those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case; 4, group size related prior probabilities are for group1 = 0.433, for group 2 = 0.40, and for group 3 = 0.167; 5, 86.7% of original grouped cases correctly classified (with prior probabilities related to group size); 6, 76.7% of cross-validated grouped cases correctly classified (with prior probabilities related to group size).

		Segment	Predicted group membership 1, 2				Predicted group membership (prior probability computed from group size) 4, 5, 6		
			1	2	3	total	1	2	3
Original	count	1	9	0	4	13	12	0	1
		2	0	12	0	12	0	12	0
		3	1	1	3	5	2	1	2
	%	1	69.2	0.0	30.8	100	92.3	0.0	7.7
		2	0.0	100	0.0	100	0	100	0.0
		3	20.0	20.0	60.0	100	40.0	20.0	40.0
Cross- validated 3	count	1	8	0	5	13	10	0	3
		2	0	12	0	12	0.0	12	0
		3	2	1	2	5	3	1	1
	%	1	61.5	0.0	38.5	100	76.9	0.0	23.1
		2	0.0	100	0.0	100	0.0	100	0.0
		3	40.0	20.0	40.0	100	60.0	20.0	20.0

Table 6. Test of equality of group means for the femora. Abbreviations: df 1, df 2, degree of freedom; F, F-distribution for univariate ANOVA. X, Y, Uniform X and Uniform Y are partial warps coordinates (variables). Variables with a significance value lower than 0.01 are marked in greyscale and are used to differentiate between groups.

Partial warps	Wilks` Lambda	F	df 1	df 2	significance
X1	0.935	0.933	2	27	0.406
Y1	0.878	1.878	2	27	0.172
X2	0.833	2.716	2	27	0.084
Y2	0.835	2.662	2	27	0.088
X3	0.687	6.155	2	27	0.006
Y3	0.780	3.808	2	27	0.035
X4	0.442	17.037	2	27	0.000
Y4	0.968	0.441	2	27	0.648
X5	0.962	0.531	2	27	0.594
Y5	0.907	1.381	2	27	0.269
X6	0.478	14.757	2	27	0.000
Y6	0.939	0.870	2	27	0.430
X7	0.574	10.034	2	27	0.001
Y7	0.787	3.664	2	27	0.039
X8	0.962	0.531	2	27	0.594
Y8	0.881	1.823	2	27	0.181
X9	0.886	1.735	2	27	0.196
Y9	0.890	1.674	2	27	0.206
Uniform X	0.929	1.038	2	27	0.368
Uniform Y	0.917	1.214	2	27	0.313

Table 7. Box's test of equality of the covariance matrices across the groups of femora. Abbreviations: df 1, df 2, degree of freedom; F-approximation, F-test approximation. The determinant's ranks and natural logarithms (ln) are taken from the group covariance matrices.

Test results		Log determinants		
Box's M-test	37.498	Segment	Rank	Log determinant
F-approximation	1.415	1	4	219.043
df 1	20	2	4	218.598
df 2	1506.566	3	4	220.920
Significance	0.105	common within groups	4	220.701

Table 8. Summary of canonical discriminant functions used for the femora. Variance: refers to the variance explained by the function.

Function	Eigenvalues	Variance (%)	Cumulative (%)	Canonical correlation
1	2.801	79.5	79.5	0.858
2	0.722	20.5	100	0.648

Table 9. Wilk's Lambda and chi² test for the humeri, for the discriminatory capabilities of the discriminant functions. c², chi2 value; df, degree of freedom for each function.

Test of functions	Wilks' Lambda	χ^2	df	significance
1 to 2	0.153	47.913	8	0.000
2	0.581	13.863	3	0.003

Table 10. Summation table for the classification of the cases, in numbers and percentage: 1, 86,7% of original grouped cases correctly classified; 2. 80.0% of cross-validated grouped cases correctly classified; 3, Cross validation is done for only those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case; 4, Group size related prior probabilities are for group1 = 0.433, for group 2 = 0.333, and for group 3 = 0.233; 5, 90.0% of original grouped cases correctly classified (with prior probabilities related to group size); 6, 80.0% of cross-validated grouped cases correctly classified (with prior probabilities related to group size).

		Segment	Predicted group membership				Predicted group membership (prior probability computed from group size) 4, 5, 6		
			1	2	3	total	1	2	3
Original	count	1	11	0	2	13	12	0	1
		2	0	10	0	10	0	9	1
		3	1	1	5	7	1	1	5
	%	1	84.6	0.0	15.4	100	92.3	0.0	7.7
		2	0.0	100	0.0	100	0.0	90.0	10.0
		3	14.3	14.3	71.4	100	14.3	14.3	71.4
Cross- validated 3	count	1	11	0	2	13	11	0	2
		2	0	9	1	10	0	9	1
		3	2	1	4	7	2	1	4
	%	1	84.6	0.0	15.4	100	84.6	0.0	15.4
		2	0.0	90.0	10.0	100	0.0	90.0	10.0
		3	28.6	14.3	57.1	100	28.6	14.3	57.1