Supplementary Information

Histology and postural change during the growth of the ceratopsian dinosaur *Psittacosaurus lujiatunensis*

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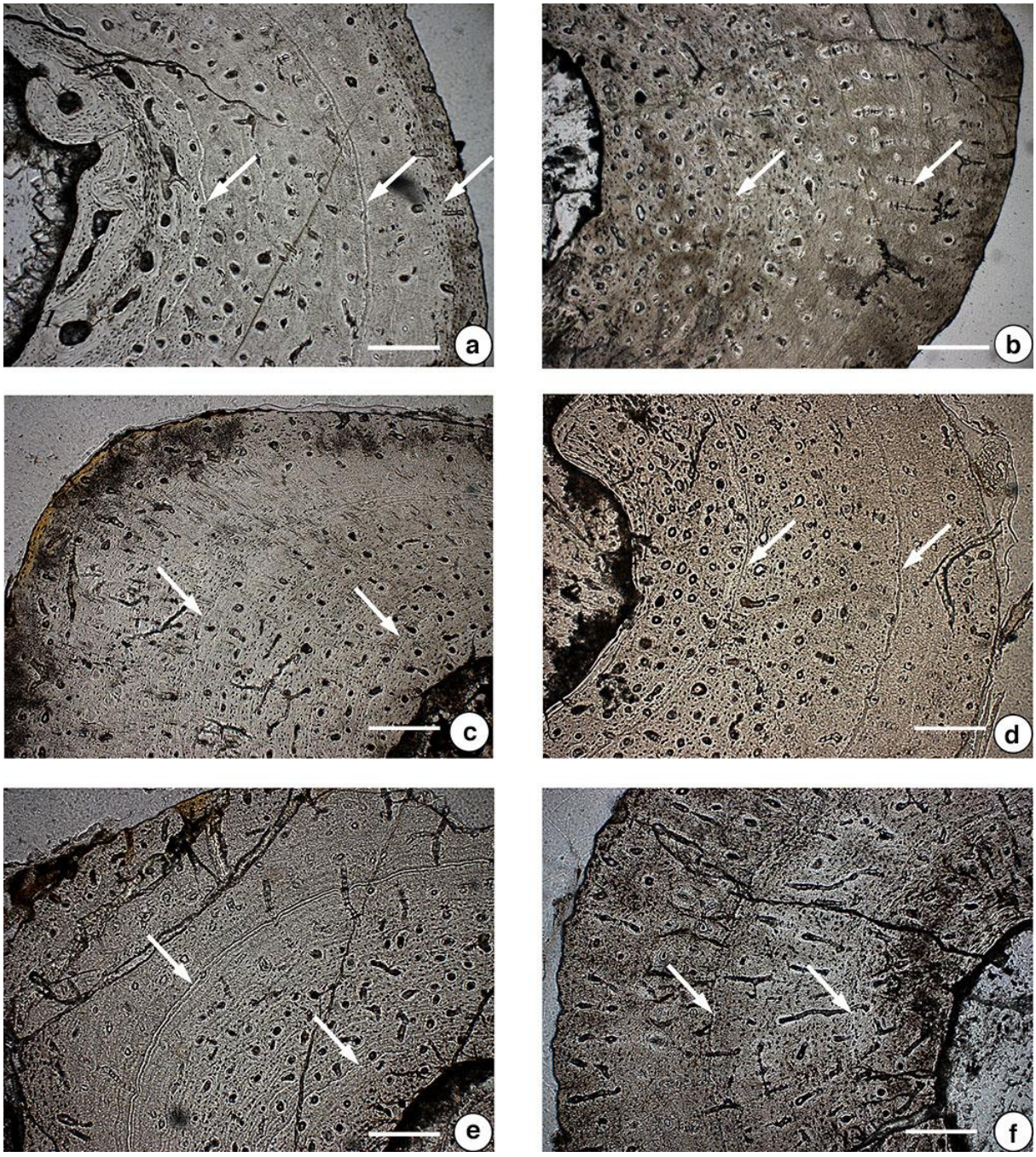
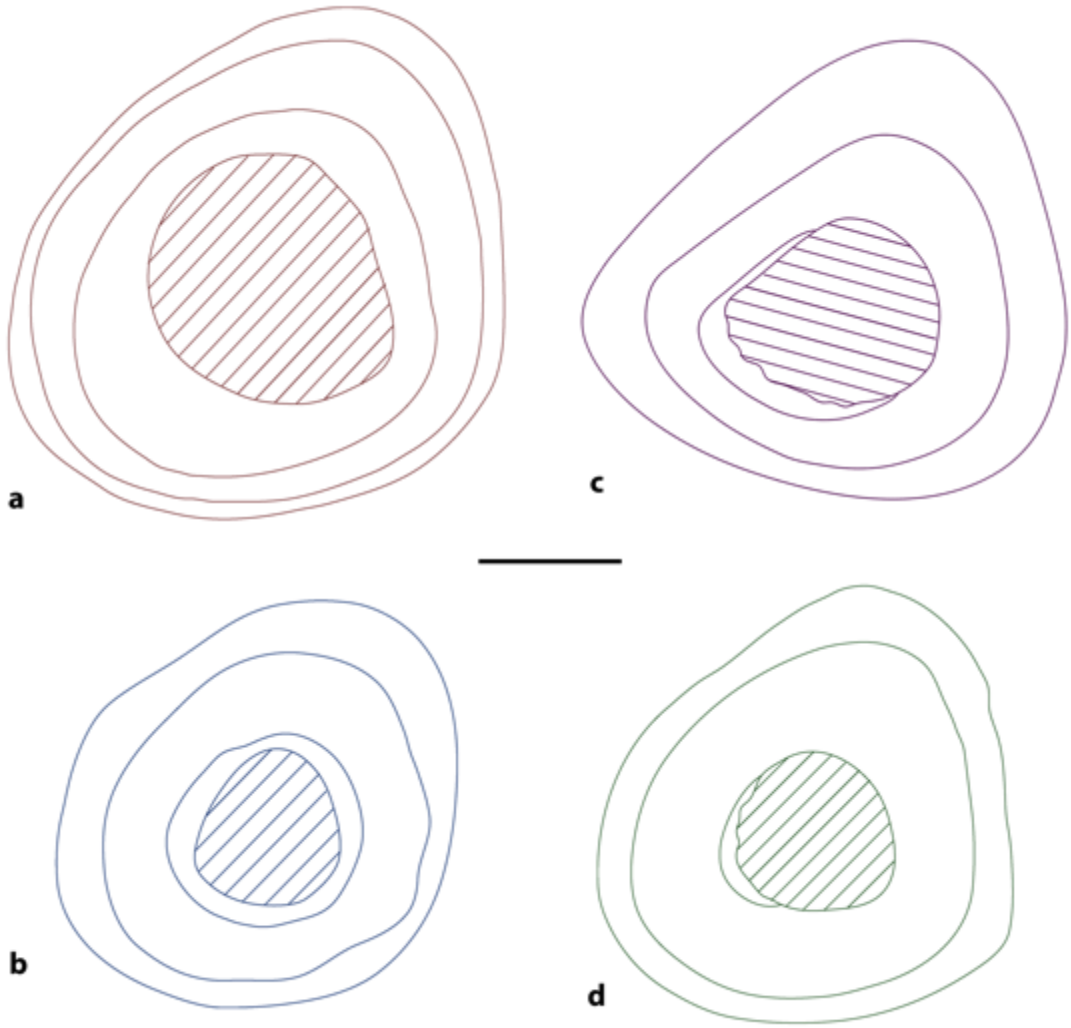
Supplementary Figures

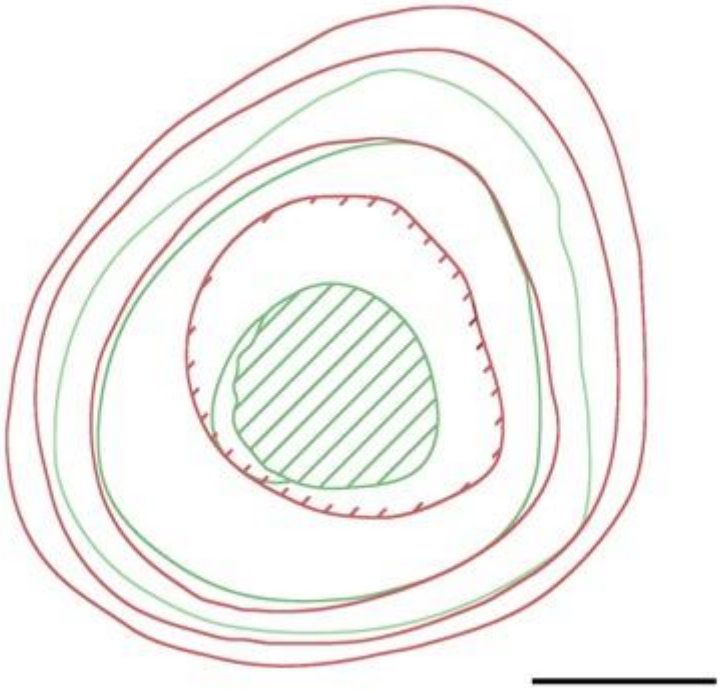


Supplementary Figure S1. Mid-diaphyseal transverse sections of IVPP V14341. Fibulae of the *Psittacosaurus lujiatunensis* specimens IVPP V14341.1 (Fig. S1a), IVPP V14341.2 (Fig. S1b), IVPP V14341.3 (Fig. S1c), IVPP V14341.4 (Fig. S1d) and IVPP V14341.5 (Fig. S1e) were sectioned, as was the radius of IVPP V14341.6 (Fig. S1f). White arrows indicate LAGs. Scale bar is 200 μm

Supplementary Figure S2. Cluster of juvenile *Psittacosaurus* specimens. This *P. lujiatunensis* cluster (ELDM V1038) contains 21 individuals. Scale bar is 10 cm.



Supplementary Figure S3. Schematic drawings of *Psittacosaurus* tibial sections. Drawings show outlines, LAGs and medullary cavities in tibial cross-sections of juvenile *P. lujiatunensis* specimens from a single cluster, including IVPP V14341.1 (a), IVPP V14341.2 (b), IVPP V14341.3 (c), IVPP V14341.4 (d). Two LAGs are visible in each cross-section, but in (c) and (d) the inner LAG has been partly obliterated. Scale bar is 2 cm.



Supplementary Figure S4. Superimposition of drawings of two *Psittacosaurus* tibial sections. Drawings show sections through the tibiae of the *P. lujiatunensis* juvenile specimens IVPP V14341.1 (brown, thick lines) and IVPP V14341.4 (green, thin lines) and correspond to Figure S3a and Figure S3d respectively. Superimposition of the two drawings indicates that the innermost LAG of IVPP V14341.4 would fit entirely within the medullary cavity of IVPP V14341.1 (hatched line), so the innermost LAG can be inferred to have been obliterated by medullary cavity expansion in the latter specimen. IVPP V14341.1 is therefore interpreted as a three-year-old, despite the presence of only two visible LAGs.

Supplementary Tables

	Humerus	Ulna	Radius	Femur	Tibia	Fibula	Age
IVPP V16902.1				0	0		<1
IVPP V16902.2	0			0			<1
IVPP V16902.3					0		<1
ELDM V1037					1		1
ELDM V1038.21	2	2		2	2		2
ELDM V1038.15					2	2	2
ELDM V1038.11	2	2		2	2	2	2
IVPP V14341.2					2	2	2
IVPP V14341.3					2	2	2
IVPP V14341.4					2	2	2
IVPP V14341.5					2	2	2
IVPP V14341.6	2	2	2				2
IVPP V14341.1	3			3	2 (1)	3	3
IVPP V14748				3 (2)	3 (2)		5
IVPP V14749	4 (1)			3 (2)	3 (2)		5
IVPP V18343						6 (1)	7
IVPP V18344						6 (1)	7
IVPP V12617	7(3)		5 (2)		8 (2)		10

Supplementary Table S1. Numbers of LAGs in thin sections made during this study. Values in parentheses represent additional LAGs that are inferred to have been obliterated by expansion of the medullary cavity. An age estimate is given for each specimen, based on the evidence from all of the thin sections taken for that specimen. For IVPP V12617, the cross-section through the radius suggested a younger age (seven years) than cross-sections through the other sampled bones (ten years). However, only one juvenile radius was sectioned in our study, and it is possible that we have underestimated the number of LAGs obliterated by medullary cavity expansion in the radius of IVPP V12617.

	Specimen number	Humerus	Radius	Ulna	Femur	Tibia	Fibula	FL	HL	FL/HL Ratio	Age
Hatchling	IVPP V16902.1	22	18	18	22	25	24	40	47	0.851	<1
	IVPP V16902.2	24	20	20	25	27	25	44	52	0.846	<1
	IVPP V16902.3	25	21	21	26	29	30	46	55	0.836	<1
Juvenile	ELDM V1037	32	26	28	38	44	48	58	82	0.707	1
	ELDM V1038.21	38	30	32	44	48	53	68	92	0.739	2
	ELDM V1038.15	39	31	30	46	51	54	70	97	0.721	2
	ElDM V1038.11	40	31	31	47	52	56	71	99	0.717	2
	ElDM V1038	38	28	30	47	50	52	66	97	0.680	2
	IVPP V14341.4	50	32	35	62	65	70	82	127	0.646	2
	IVPP V14341.1	62	40	42	73	82	82	102	155	0.658	3
	IVPP V14342	64	41	44	81	88	89	105	169	0.621	?
Sub-adult	IVPP V14748	90	54	59	109	119	118	144	228	0.633	5
	IVPP V14749	90	56	65	117	125	122	146	242	0.604	5
	IVPP V18343	94	64	74	132	135	135	158	267	0.592	7
	IVPP V18344	108	75	75	145	150	149	183	295	0.620	7
Adult	IVPP V12716	137	85	94	162	175	165	222	337	0.659	10

Supplementary Table S2. Measurements of *Psittacosaurus* long bones. Digits appended to specimen numbers indicate identities of individual juvenile specimens within a single cluster. All specimens are referable to *P. lujiatunensis*, come from the Lujiatun locality, and share the same age and facies information. ‘FL’, forelimb (humerus plus radius); ‘HL’, hindlimb (femur plus tibia). All measurements are lengths in mm.