Figure S1. **Illustrations of all hindlimb muscles in the cryptodire *T. scripta* (left) and the pleurodire *E. subglobosa* (right) which have shifted from the ancestral origin on the pelvis in cryptodires to an origin on the shell in pleurodires**. A,B lateral view with femur protracted, anterior is on the left; C,D lateral view with femur retracted, anterior is on the left; E,F ventral view with femur protracted, anterior is to the top. Hatched areas in F indicate the attachment of the pelvis and muscles to the shell. Yellow, Puboischiofemoralis internus (PIFI); Red, Iliofemoralis (ILF); Blue, Femorotibialis (FT); Green, Flexor tibialis internus (FTI); Purple, Caudi-iliofemoralis (CIF). Pink muscles are those not examined in this study. A-D, Dorsal muscles, Iliotibialis (anterior), Iliofibularis (posterior). E,F, Ventral muscles, anterior to posterior, ambiens, pubo-tibialis, adductor femoris, ischiotrochantericus.
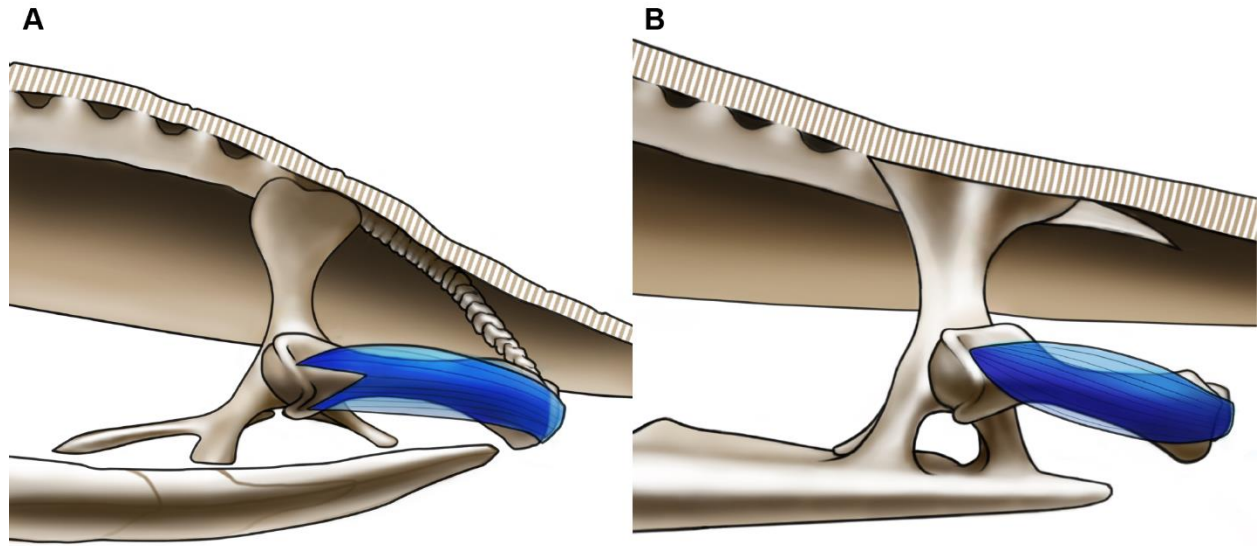
Figure S2. **Isolated femorotibialis muscle (blue) in the cryptodire *T. scripta* (A) and pleurodire *E. globosa* (B)**. This muscle is not associated with the hip joint, and demonstrates no substantial change in muscle origin between the two lineages.

Table S1: Hindlimb muscle use data collected from cryptodire and pleurodire turtles while swimming and walking.

Muscle	Swimming		Walking	
	Cryptodire	Pleurodire	Cryptodire	Pleurodire
PIFI	3, 44	3, 74	2, 32	3, 66
ILF	3, 48	3, 40	3, 47	1, 23
FT	3, 51	1, 28	3, 51	1, 26
FTI	3, 50	3, 69	3, 43	3, 78
CIF	2, 33	3, 65	2, 36	3, 43

Numbers for each lineage indicate sample sizes for each muscle during each behavior (individuals, cycles). PIFI, puboischiofemoralis internus; ILF, iliofemoralis; FT, femorotibialis; FTI, flexor tibialis internus; CIF, caudi-iliofemoralis.

Table S2. Muscle activity patterns during locomotion while swimming and walking in cryptodire and pleurodire turtles.

Muscle	Action	Swim		Walk		Canon 1	Canon 2
		Cryptodire	Pleurodire	Cryptodire	Pleurodire		
PIFI	On	43.08 ± 1.38	48.35 ± 0.45	53.12 ± 1.22	77.96 ± 0.73	0.41	-0.26
	Off	82.80 ± 0.83	89.23 ± 0.27	86.53 ± 1.01	101.76 ± 0.32	0.40	0.30
ILF	On	35.37 ± 1.21	55.18 ± 1.76	46.83 ± 1.20	76.57 ± 0.99	0.14	-0.07
	Off	65.09 ± 1.07	84.11 ± 1.52	74.83 ± 1.27	98.35 ± 0.47	0.46	0.29
FT stance	On			5.24 ± 0.97	31.87 ± 1.85		
	Off			38.54 ± 1.01	51.58 ± 1.43		
FT swing	On	75.05 ± 0.74	82.58 ± 0.75	84.18 ± 0.60	87.59 ± 0.82	0.33	-0.39
	Off	91.25 ± 0.65	104.02 ± 0.72	93.95 ± 0.60	99.62 ± 0.26	0.06	0.97
FTI	On	-3.38 ± 0.74	-0.96 ± 0.66	-0.71 ± 0.86	0.49 ± 0.36	-0.22	0.05
	Off	22.29 ± 1.21	18.43 ± 1.13	28.50 ± 0.93	53.60 ± 1.16	0.54	-0.12
CIF	On	-4.23 ± 0.73	1.82 ± 0.50	-0.14 ± 0.39	1.50 ± 0.60	0.07	0.46
	Off	19.94 ± 1.26	22.27 ± 0.61	30.73 ± 0.89	47.35 ± 1.48	0.41	-0.48

Values are mean ± SE activity timing (in percentage of limb cycle, with 0 when the limb is fully protracted). Canonical values are loaded scores for each variable in the CDA. PIFI, puboischiofemoralis internus; ILF, iliofemoralis; FT, femorotibialis; FTI, flexor tibialis internus; CIF, caudi-iliofemoralis.

Table S3. Kinematics of cryptodire and pleurodire turtles, with p values, overall effects size (Ω^2), effects size of species (Cohen's d) for each environment, as well as the canonical discriminant loadings for the overall data.

	Swimming					Walking					Canon	Canon
	Cryptodire	Pleurodire	p	Ω^2	D	Cryptodire	Pleurodire	p	Ω^2	D	1	2
Max Pro	63.4 ± 0.8	47.1 ± 0.5	<0.001	0.861	2.333	69.6 ± 0.5	64.2 ± 0.7	0.094	0.842	0.867	0.83	0.05
Max Ret	-11.4 ± 1.9	-26.6 ± 0.6	0.005	0.682	1.254	-1.4 ± 2.7	-13.2 ± 1.4	0.234	0.728	0.578	0.13	0.16
Max El	-4.7 ± 0.6	-10.8 ± 0.6	0.029	0.710	0.949	-1.4 ± 0.4	-7.9 ± 0.4	<0.001	0.685	1.646	0.05	0.25
Max Dep	-21.3 ± 0.7	-28.1 ± 0.7	0.136	0.750	0.839	-18.8 ± 0.4	-26.0 ± 0.5	0.003	0.772	1.509	-0.18	0.31
Knee Ext	109.4 ± 1.5	130.7 ± 1.0	0.001	0.805	-1.658	107.5 ± 2.3	121.6 ± 1.5	0.171	0.806	0.748	0.36	-0.33
Knee Flex	50.7 ± 1.0	64.8 ± 1.2	0.003	0.801	-1.177	49.7 ± 1.5	66.9 ± 1.6	0.068	0.888	-1.067	0.50	-0.67
Ankle Ext	81.6 ± 1.5	80.1 ± 1.2	0.382	0.688	0.100	93.5 ± 2.5	96.9 ± 2.1	0.877	0.695	-0.155	0.35	-0.58
Ankle Flex	30.6 ± 1.4	19.5 ± 1.2	0.402	0.879	0.781	34.1 ± 1.6	41.9 ± 1.9	0.428	0.708	-0.436	0.18	-0.26
Max Feath	67.3 ± 2.3	85.4 ± 1.2	0.004	0.757	-1.059	27.0 ± 1.3	25.2 ± 1.4	0.998	0.690	0.125	-1.18	0.05
Min Feath	-0.4 ± 2.2	3.6 ± 1.3	0.343	0.622	-0.226	-4.9 ± 1.3	-9.7 ± 0.6	0.622	0.743	0.338	0.62	0.11

Values are mean angles ± SE. p values reported are those from mixed effects models, Ω^2 provides an effects size for the overall model, and D represents the Cohen's d value for the main effect in the model (species). N = 5 individuals, 84 cycles for cryptodire swimming, and 88 cycles for cryptodire walking; N = 6 individuals, 149 cycles for pleurodire swimming, and 116 cycles for pleurodire walking. Max Pro, Maximum protraction; Max Ret, maximum retraction; Max El, Maximum elevation; Max dep, Maximum depression; Knee Ext, Maximum knee extension; Knee Flex, Maximum knee flexion; Ankle Ext, maximum ankle extention; Ankle Flex, maximum ankle flexion; Max Feath, Maximum angle of pes; Min Feath, minimum angle of pes.