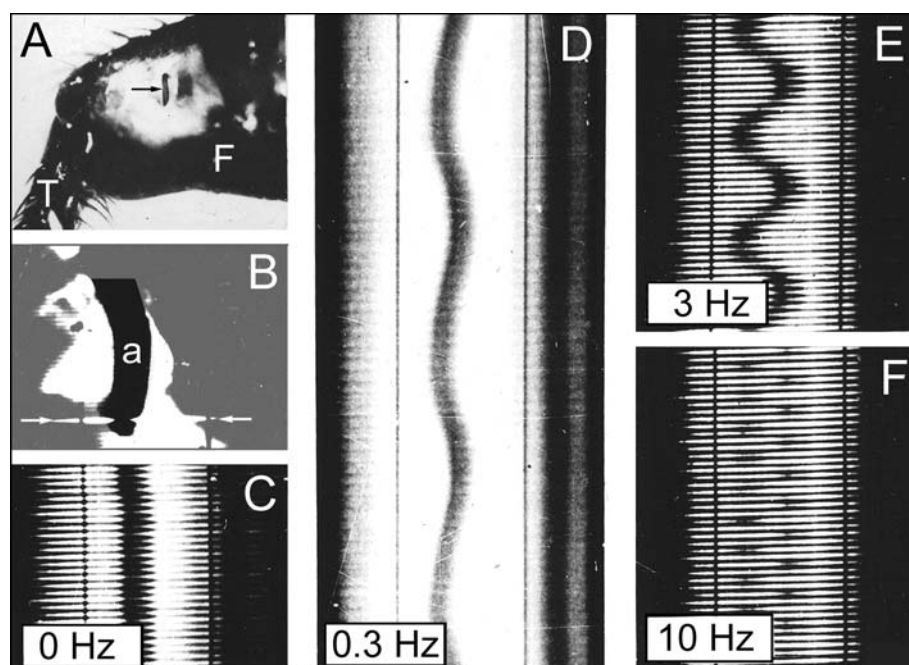


Supplementary materials

Table S1. Mechanical parameters of arcula in separated legs of some beetles*.

Family	Species	shape of the arculum	Time constant, s	Max. angular amplification
Carabidae	<i>Cicindela hybrida</i> L.	straight	?	>1
	<i>Carabus cancellatus</i> Ill.	straight	?	7.3
Dytiscidae	<i>Dytiscus marginalis</i> L.	straight	–	–
Geotrupidae	<i>Geotrupes stercorarius</i> L.,	curved	1.24	5.8
	<i>Geotrupes stercorosus</i> Scriba	curved	0.945	6.3
	<i>Lethrus apterus</i> Laxm.	curved	0.435	28.3
Buprestidae	<i>Chalcophora mariana</i> L.	curved	1.95	7.2

*Parameters in *Cicindela hybrida* were not measured because of the small size of this beetle. In *Dytiscus marginalis*, a triangular sclerite, connected to a ligament, was immobile.

Fig. S1.

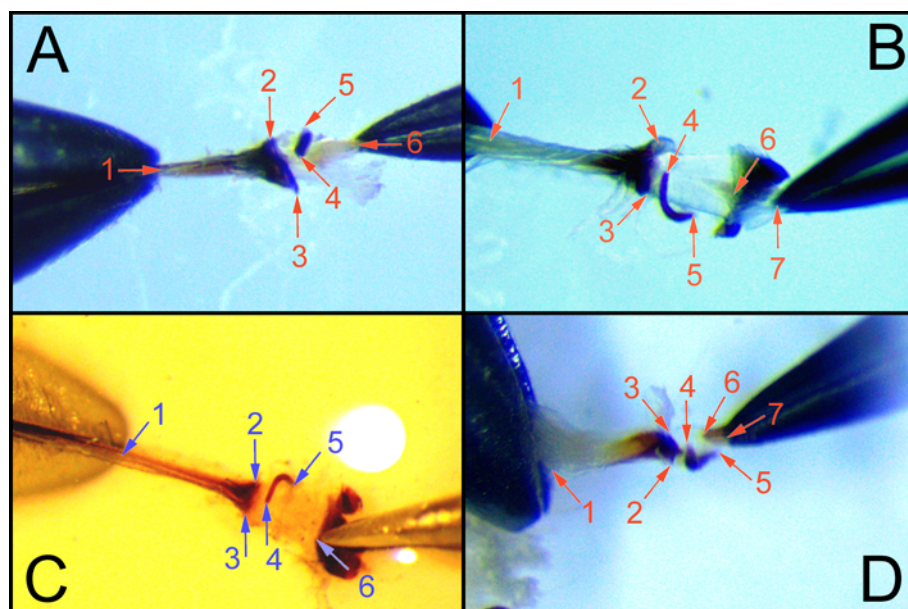
Video kymography of the oscillating arculum responding to small oscillations of the tibia. (A) The arculum (indicated with a small arrow) is exposed in a window cut in the anterior face of the femur in *Geotrupes stercorosus*. (B) Video image of a window with the arculum (highlighted as the contrast black element against the low contrast background) in *Lethrus apterus*. Position of the slit across the tip of the arculum is indicated with two white arrows. This image in the slit was recorded on the running film. (C-F) Records of oscillations in *L. apterus* on the running film. Amplitude of imposed oscillations in the arculum is moderate at 0.3 Hz, but larger at 3-10 Hz. Abbreviations: a arculum, F femur, T tibia.

Table S2. List of recently inspected beetle species [families classified by Lawrence et al., 2011*].

Higher taxa	Family	Species
Archostemmata	Cupedidae	<i>Priacma serrata</i> (Leconte, 1861)
Adephaga	Carabidae	<i>Carabus glabratus</i> Paykull, 1790
		<i>Calosoma inquisitor</i> (Linnaeus, 1758);
		<i>Anthia mannerheimi</i> Chaudoir, 1842
Polyphaga, Hydrophiloidea	Hydrophilidae	<i>Hydrous piceus</i> (Linnaeus, 1758)
Polyphaga, Scarabaeoidea	Geotrupidae	<i>Lethrus apterus</i> Laxmann, 1770
	Lucanidae	<i>Lucanus cervus</i> Linnaeus, 1758
	Scarabaeidae	<i>Melolontha melolontha</i> Linnaeus, 1775
		<i>Pentodon idiota</i> Herbst, 1789
		<i>Allomyrina dichotoma</i> (Linnaeus, 1771)
		<i>Megasoma elephas</i> Fabricius, 1775
Polyphaga, Buprestoidea	Buprestidae	<i>Chalcophora mariana</i> (Linnaeus, 1758)
Polyphaga, Tenebrionoidea	Tenebrionidae	<i>Zophobas atratus</i> (Fabricius, 1775)
	Meloidae	<i>Meloë proscarabaeus</i> Linnaeus, 1758
Polyphaga, Chrysomeloidea	Cerambycidae	<i>Prionus coriarius</i> Linnaeus, 1758

* Lawrence, J. F., Ślipiński, A., Seago, A. E., Thayer, M. K., Newton, A. F. and Marvaldi, A. E., 2011. Phylogeny of the Coleoptera based on morphological characters of adults and larvae. *Annales Zoologici* (Warszawa) 61, 1-217.

Fig. S2.



Relevant points for measurements of arculum oscillations in video frames. (A) *Calosoma inquisitor*, (B, C) *Lethrus apterus*, (D) *Chalcophora mariana*. Points are indicated by arrows. Location of points: 1 – grip of the left forceps; 2, 3 – markers at the edge of the cup; 4, 5 – base and tip of the arculum; 6 in A, C; 7 in B, D – grip of the right forceps by the tibial ledge; 6 in B, D – distal edge of the tendon. View image at magnification 200% for details.

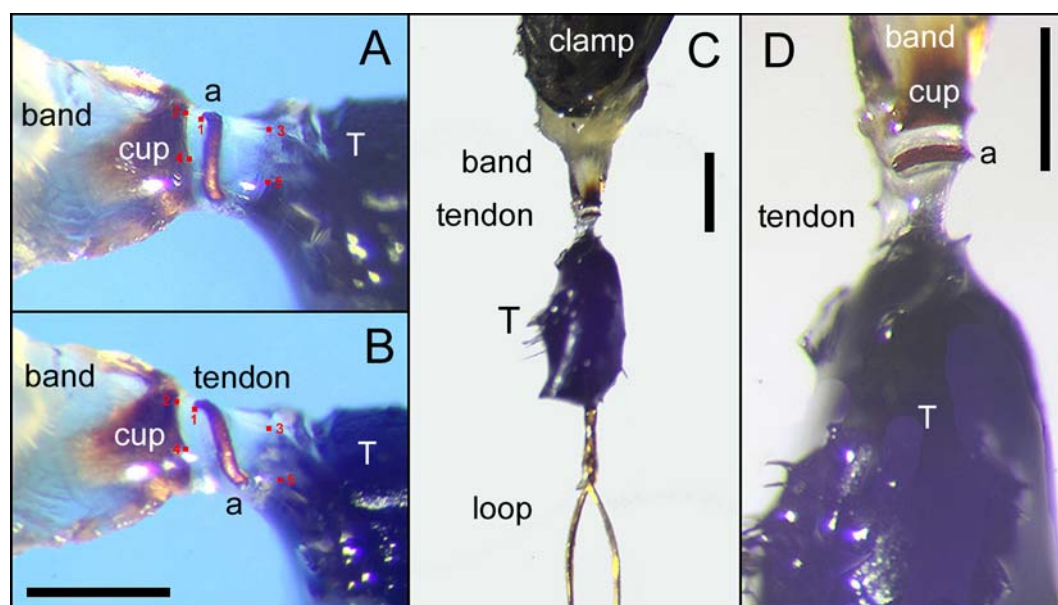
Table S3. Correlation between frame by frame deviations from mean projections onto the line between two grips (forceps1 – forceps2) for pairs of relevant points.

Genus	AVI file *	D.O.F	Correlation for pairs of relevant points, (P_0 , in %)			
			tip/forceps2	tip/tendon	base/tibia	tendons 1/2
<i>Calosoma</i>	movie1_Inq	171	0.389 (<0.1)		0.361 (<0.1)	0.317 (<1)
<i>Lethrus</i>	Leth1C	37	0.705 (<0.1)		-0.044 (ns)	-0.398 (<1)
	Leth1A	58	0.241 (ns)		0.023 (ns)	-0.021 (ns)
	Leth1B	27	0.857 (<0.1)		-0.258 (ns)	-0, 145 (ns)
	Leth2B	32	0.504 (<1)		-0.004 (ns)	0.186 (ns)
	Leth2A	34	0.497 (<1)	0.491 (<1)		
	movie2_Leth	58	0.195 (ns)	0.523 (<0.1)		
	Leth3A	99	0.663 (<0.1)		-0.048 (ns)	-0.198 (<5)
<i>Pentodon</i>	movie3_Pen	170	0.898 (<0.1)	0.824 (<0.1)	0.556 (<0.1)	
	Pent2R1 **	83	0.032 (ns)			
<i>Chalcophora</i>	movie4_Chal	104	0.706 (<0.1)	0.781 (<0.1)	0.732 (<0.1)	-0.635 (<0.1)

Abbreviations: D.O.F. degrees of freedom, ns non-significant, P_0 probability of the null hypothesis.

*Movies, available at the Website (<http://izan.kiev.ua/ppages/frantsevich/arc.htm>), are printed bold.

** Vague performance of the arculum in the specimen filmed in Pent2R1.avi was caused by broad light reflexion around the fine forceps, which rendered poor localization of the relevant point.

Fig. S3.

Evaluation of strain in the MET tendon of *Lethrus apterus*. (A) Neutral state of the MET tendon and the arculum in a micromanipulator between a clamp holding the MET apodeme and an unstrained spring holding the tibia. (B) The same specimen is stretched via the spring until the arculum turns to the limit. Relevant points for measurements: 1 base of the arculum; 2, 3 marks of the tendon length at the dorsal side; 4, 5 same at the ventral side. (C) A specimen of the MET apodeme, the tendon and a piece of the tibia hangs between a clamp and a wire loop to which various weights are suspended. (D) Magnified image of the tendon and the arculum in the same specimen. Scale bars: (A, B; D) 0.5 mm, (C) 1 mm. Abbreviation: a arculum, T tibia. View reference points at magnification 200 %.