Contact Mechanics and Articulation of the Frictional Latch Mediating Function of the Snap Maneuver in Elaterid Beetles

BIOTRIBOLOGY

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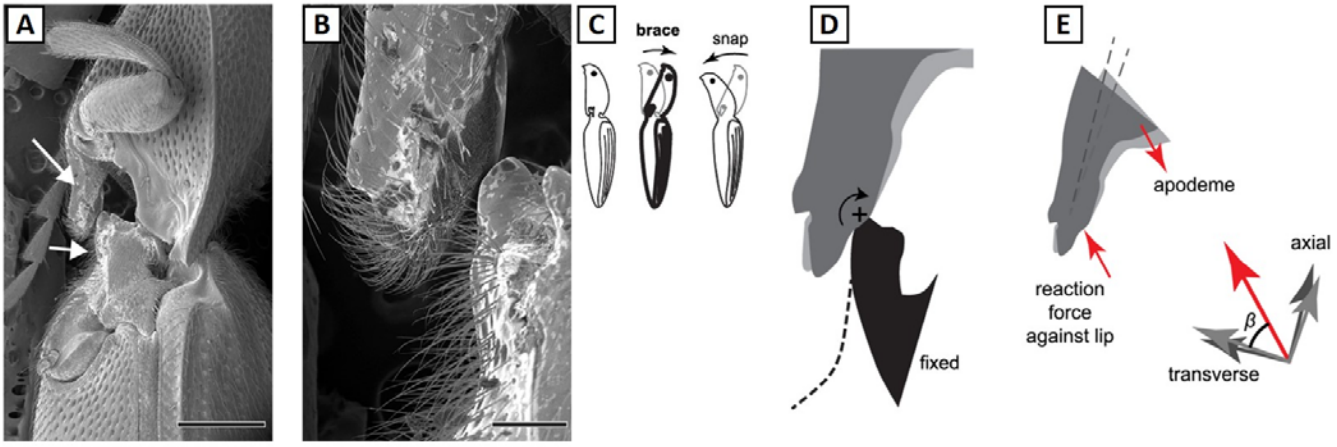
Effective energy storage and release is required for survival of insects. Elaterid beetles, known familiarly as 'click' beetles or 'skipjacks,' respond to physical stimulus is by an audible and tangible snap, executed within the hinge between their body segments with no external leverage required [1-3]. This is similar to the explosive power release of the mantis shrimp and the trapjaw ant [4,5]. The aim of this study is to use recorded images of the snap maneuver to identify the function of the friction latch at the hinge.

Scanning electron microscopy (SEM) was used to identify the geometry of the anatomy of the interface (Figure A). A peg protrudes from the prothorax, and mates against a lip on the mesosternum in a 'brace' position just before the snap initiates (Figure B-C). High-speed x-ray video reveals a rotation of the peg locally against the lip just before snap, which appears to redistribute the reaction forces (Figure D-E). The slight angle change simultaneously orients the force more laterally to overcome friction, and decreases the normal force at the interface, allowing for slip. This new understanding allows for more sophisticated modeling of the contact area and local contours which support the load throughout the critical slip event.



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