Randall, J. B. 1982. Coxal relocation following the loss of an adjacent coxa in *Latrodectus variolus* (Walckenaer). J. Arachnol., 10:247-250.

COXAL RELOCATION FOLLOWING THE LOSS OF AN ADJACENT COXA IN *LATRODECTUS VARIOLUS* (WALCKENAER)

John B. Randall[1]

Department of Biological Sciences
State University of New York at Buffalo
Buffalo, New York 14260 U.S.A.

ABSTRACT

Removal of the coxa from fourth instar female *Latrodectus variolus* results in wound healing with no subsequent regeneration in the 20-25% surviving this drastic surgical procedure. Following subsequent molts the coxa adjacent to the amputation site moves into the area vacated by the amputation.

INTRODUCTION

The demonstrated ability of arthropods to detach their own limbs has been defined as autotomy (Frédéricq 1883), autospasy (Piéron 1907) and autotilly (Wood and Wood 1932). Autotomy is defined as a well developed, usually unisegmental reflex resulting in the loss of an arthropod's own limb. Autospasy is the separation of a limb from the body when it is subjected to an outside force against the resistence of the animal's weight or efforts to escape. Autotilly is removal of a limb by the animal using its own mouthparts. Woodruff (1937) adopted the term "appendotomy" to include all three definitions. The point common to the three categories of appendotomy exhibited by spiders in a predetermined plane of weakness (also called breakage plane, autotomy plane, plane of least resistence or locus of weakness) located at the coxa-trochanter joint.

It has been demonstrated that some spiders, *Dolomedes* (Bonnet 1930) and *Peucetia viridans* (Hentz) (Randall, unpublished data) regenerate appendages lost through appendotomy while others, *Latrodectus variolus* (Walckenaer) (Randall 1981) and *L. mactans* (Fabricius) (Randall, unpublished data) do not regenerate appendotomized limbs. Following appendotomy *L. variolus* and *L. mactans* have left only the coxa of the lost appendage even following subsequent molts.

The autotomy mechanism of spiders acts to minimize blood loss when a limb is detached at the plane of weakness (Parry 1957). Randall (1981) found that amputation of the coxa from fourth instar *L. variolus* resulted in wound healing, in the few spiders surviving the surgery, with no subsequent regeneration. With the coxa removed the mechanism reducing blood loss was eliminated, thus increasing blood loss and the probability of infection, both of which can contribute to the high mortality observed for this surgical procedure.

[1]Present address: #7 Twaddell Mill Road, Wilmington, Delaware 19807

The objective of the present work was to follow an observation that the leg adjacent to an amputated coxa had moved anteriorly following post-injury molts.

METHODS

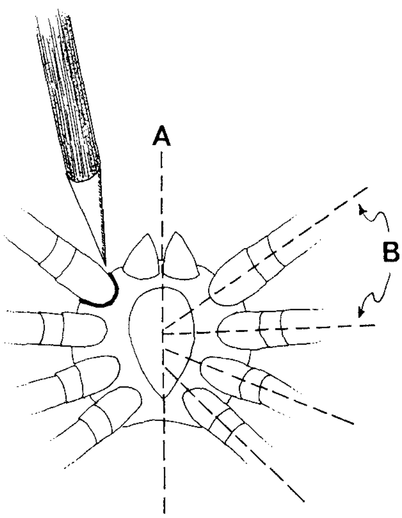
The first right leg of 20 fourth instar *L. variolus* was surgically removed between the coxa and the pleura (Fig. 1). This is an immovable joint. Spiders were maintained in individual containers at 27°C and 80% RH and fed apterous *Drosophila melanogaster*. Following subsequent molts the spiders were placed in an observation apparatus (Randall 1978) ventral side up and examined through a dissecting microscope equipped with a camera lucida drawing attachment. Drawings were made of each spider's sternum and coxae. Drawings were analyzed by measuring the angle between the lines drawn that longitudinally bisected the sternum (Fig. 1, line A) and the lines longitudinally bisecting each coxa (Fig. 1, line B). Angles were measured where lines B and line A intersected thereby allowing for the comparison of coxal location following each post-injury molt.

RESULTS

Five (25%) of the 20 spiders survived to subsequent instars. Mortality was greatest (90%) within the first four post-operative days.

The normal angles of coxae I-IV were: Leg I, 53°; Leg II, 88°; Leg III, 114°; and Leg IV, 119°; all ± 2° (N = 20).

The results of coxal amputation are shown in Figure 2. Following the first Post-amputation molt the wound healed leaving a flat, smooth scar area. The angle of the



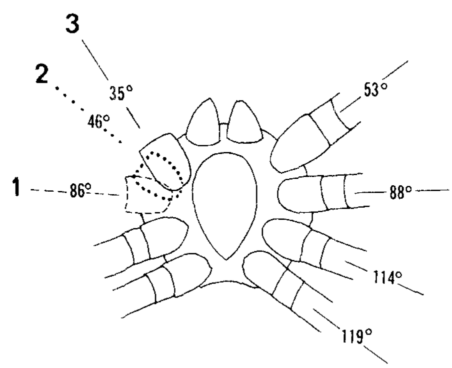


Fig. 1.–Diagram indicating the location of coxal amputation and the lines used in the analysis of coxal relocation.

Fig. 2.–Normal angles of the coxae of *L. variolus* (right) and the sequence of the relocation of coxa II on *L. variolus* in response to the amputation of the adjacent coxa I (left); large numerals indicate post-amputation molts.

adjacent coxa (coxa II) was 86° ± 2° (N = 5). After the second post-amputation molt the coxa of leg II had moved anteriorly to 46° ± 2° (N = 5) then to 35° ± 2° (N = 4) following the third post-amputation molt. No more than three post-injury molts were observed because the spiders had either matured or died. Relocation of the coxae of legs adjacent to autotomized legs, where the coxa of the missing leg was still intact was not observed (N = 53).

DISCUSSION

Compensatory movement of the coxa, and consequently the entire leg, of appendages adjacent to a spider leg amputated at the coxa has not been previously reported. Coxal relocation is not a normal occurrence since the spider is equipped with a mechanism for detachment of the limb at the coxa-trochanter joint as a means of escape or elimination of a badly injured limb, leaving the coxa of the injured limb intact. It is highly unlikely that the circumstances leading to coxal relocation in response to the loss of an adjacent coxa would occur in nature due to the efficiency of the spider's appendotomy mechanism and the improbability of injury to a single coxa. This is further compounded by the mortality associated with coxal amputation, high even under seemingly ideal laboratory conditions, which might occur in the field should the appendotomy mechanism fail or be by passed by injury proximal to the coxa-trochanter joint (the appendotomy plane). The fact that coxal relocation occurs at all indicates the value of this system's existence for the very small portion of a population that could survive the sequence of events leading to its implementation under natural conditions.

The developmental implications of the relocation of the spider's coxa are great since the spatial arrangement of the cells and tissues involved have been altered. What signals the relocation procedure to commence and cease? Since the movement is into the area vacated by the loss of the adjacent coxa it is assumed this is a compensatory reaction. However, the relocation of coxa II in *L. variolus* does not occur in response to the loss of the leg distal to the coxa, only to the loss of the coxa. Appendotomized limbs (legs and pedipalps) of *L. variolus* are not replaced by regeneration (Randall, 1981 and unpublished data) leaving only the coxa of the lost limb with no relocation of the adjacent coxa.

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