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Evaluation of Three Commercial Tick Removal Tools

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source: *Wilderness and Environmental Medicine*, **9**, 137-142 (1998)

Abstract

We evaluated three commercially available tick removal tools against medium-tipped tweezers. Three inexperienced users randomly removed attached American dog ticks (*Dermacentor variabilis*) and lone star ticks (*Amblyomma americanum L.*), from laboratory rabbits in a university animal facility. Tick damage occurring from removal and quantity of attachment cement were compared. No tool removed nymphs without damage and all tools removed adults of both species successfully. American dog ticks proved easier to remove than lone star ticks, whose mouthparts often remained in the skin. Nymphal ticks were consistently removed more successfully with commercial tools when compared to tweezers. The commercial tick removal tools tested were functional for removal of nymphs and adults, and should be considered as viable alternatives to medium-tipped tweezers. Most importantly, use of these tools may encourage reluctant people to promptly remove ticks rather than delaying or using dangerous ineffective folk methods. When tick parasitism cannot be avoided, prompt removal is the next best alternative for reducing infection risk.

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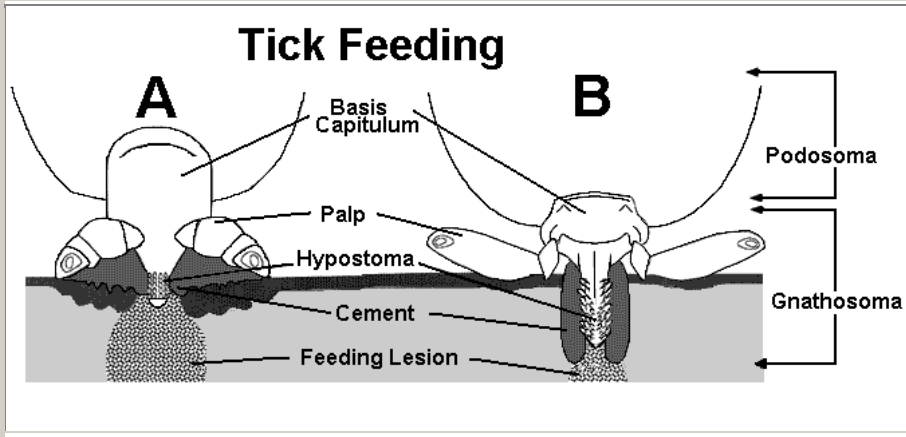
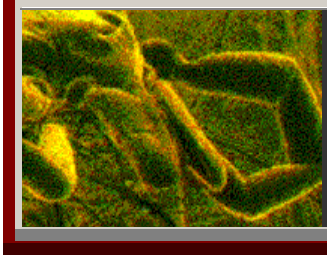


Figure 1. Diagram of tick feeding. Tick A represents a superficial species, such as the American dog tick (*Dermacentor variabilis*). Tick B represents a more deeply attached species, such as the lone star tick (*Amblyomma americanum*). The leg bearing section is denoted the podosoma while the head region, the gnathosoma. When removal is attempted, the target region for contact with any removal instrument should be between the podosoma and gnathosoma at the basis capitulum.



QuickTime movie of a tick feeding.

Movie courtesy of Mona Lisa Production

Note: *QuickTime* or *Windows Media Player* is required to view the movie.

Introduction

Although mosquitoes transmit a greater variety of pathogens than all other arthropods, tick-borne Lyme disease remains the most commonly reported arthropod-borne disease in the United States. Other tick-borne diseases such as Rocky Mountain spotted fever, babesiosis, anaplasmosis and ehrlichiosis tend to be of regional significance.

Ticks, potentially infected with disease causing agents, present an often-unrecognized risk associated with the wilderness habitat. Many people neglect to do frequent tick checks to interrupt feeding. The most effective method of interrupting tick feeding and stopping potential disease agent exchange is to mechanically remove the tick.

The attachment period required to initiate an infection varies for each pathogen. The interval required for *Borrelia burgdorferi* (Lyme disease) to be transmitted by the Eastern black-legged tick, *Ixodes scapularis* , (commonly known as the "deer tick") and the Western black-legged tick, *I. pacificus* , are reported to be >24 hr for nymphal and 36 hr for adult *I. scapularis* and 96 hr for *I. pacificus* nymphs. In the European sheep tick, *I. ricinus* , the interval required for *B. burgdorferi* to be transmitted to ticks is slightly less (16.7 hr). These transmission times are not absolute and can be shortened if a tick has a systemic rather than the more typical gut infection. Other published potential "safety intervals" include transmission times for *Rickettsia rickettsii* (Rocky Mountain spotted fever bacterium) at more than 24 hr and *Babesia microti* (Babesiosis) at greater than 54 hr. Much more information is needed to account for many unknown variables before reliable safety intervals can be established. Part of the lag interval associated with pathogen transmission is likely a result of the continual attachment process. Attachment involves inserting the hypostome (Fig. 1) into the skin and depositing cement. Cement is a white substance secreted into the wound where it serves as both a gasket and a holdfast material. Cement abundance, deposition time and location within/on the skin varies greatly between genera and may delay initial true feeding in some species. Removal of this cement is desirable because any left behind could harbor pathogens and be a source of additional inflammation. Removal strategy appears to have no influence on a host becoming infected with Lyme disease.

The most frequently asked question of acarologists is, "How do you remove a tick?" This is commonly followed by, "What should I use?" A good answer requires knowing the relative merits of "folk" methods as well as new innovative removal tools. A few articles have been published concerning "folk" methods and several evaluate removal tools that are no longer available, however, little comparative information is available detailing the relative effectiveness of new removal tools. The purpose of this laboratory

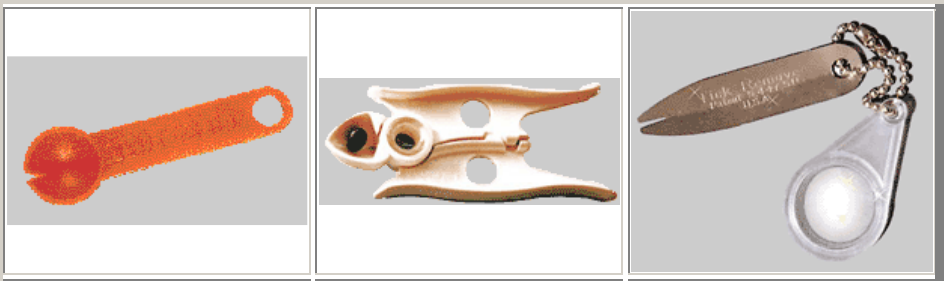
study was to evaluate three novel tools compared to medium-tipped tweezers.

Methods

Lone star and American dog ticks were obtained from a colony maintained at Oklahoma State University. Lone star ticks attach deep into the skin and their mouthpart morphology is similar in length to ticks of the genus *Ixodes*. The American dog tick has shorter mouthparts and attaches superficially into the skin (Fig. 1). These two species were chosen as representatives for their two distinct attachment strategies and because they are common in the United States.

All ticks were removed from the shaved backs of laboratory rabbits by three untrained individuals 23-30 hr post-infestation. The untrained individuals had no prior experience with the removal tools and did not work with tweezers on a daily basis. The individuals were encouraged to follow the manufacturer's instructions or were handed tweezers without instruction. Once the ticks were removed, they were placed in 70% ethanol for microscopic evaluation of mouthparts and associated cement.

The makers of these tools employ two distinct removal strategies. One design strategy is to grasp the mouthparts with fine edges or points at the bite site and remove the tick by gently pulling away from the skin. Both medium-tipped tweezer and the *Tick Nipper* function in this manner. The other design is to use a slit in the removal tool large enough to accommodate the mouthparts but too narrow for the tick's body to pass. This strategy forces the tick's mouthparts within a "V" slot through the forward motion of the tool and then the tick is lifted from the skin. The *Pro-Tick Remedy* and *Ticked-Off* tools are designed for this function (Fig. 2).



Ticked-Off	Tick Nipper	Pro-Tick Remedy

Figure 2. Several commercially available tick removal tools.

Discussion

Tick attachment strategy, mouthpart morphology and body size clearly influences how well the devices work in the hands of novice users. Deeply-attached adult lone star ticks were difficult to remove using all methods, while American dog tick adults presented little difficulty. The two methods utilized by these instruments, grasping the tick or providing a "V"-shaped slot too narrow for the tick's body to pass, appeared to have little influence on tool effectiveness. However, the *Tick Nipper* and medium-tipped tweezers appear slightly more effective than *Pro-Tick Remedy* and *Ticked-Off* for removing

adult lone star ticks. The narrow base of the "V" slot may cut the mouthparts at the base since the major differences between strategies were observed solely in the mouthpart region. Using medium-tipped tweezers or the *Tick Nipper* for lone star adults yield slightly better results than the other two tools although all functioned adequately.

The removal of deeply attached nymphs presented problems for both removal designs. Fewer difficulties were observed with instruments using the V-shaped slot rather than grasping the tick. Because 95% of the nymphs removed with tweezers were removed without their mouthparts and anterior body halves, we do not recommend using medium-tipped tweezers for removing deeply-attached nymphs unless no other tool is available. Exposing the internal contents of a tick can be hazardous since otherwise isolated pathogens could enter the wound. Of the three commercial devices evaluated for nymphal removal,the *Pro-Tick Remedy* and *Ticked-Off* yielded slightly better results than the *Tick Nipper* because fewer ticks left their mouthparts in the skin and more cement was removed. We recommend using any of the three commercial instruments over tweezers for the removal of nymphs.

Timely removal is critical for avoiding tick-transmitted diseases by reducing the interval for pathogen entrance into the host. Numerous manuals and textbooks continue to recommend methods that extend the time a tick is attached and many are dangerous or simply fail. The most popular methods are passive and include applying ointments, ether, gasoline or petroleum so they will release their hold. Others have endorsed applying fingernail polish, and "using a suture needle (FS-2 cutting) to apply pain to the tick's face for removal." One even says "a punch biopsy will remove the tick with certainty". While this is true, what happens when one walks through vegetation that contains hundreds of "seed" (immature) ticks? Do we punch holes in the host's skin for every one of the attached ticks? Needham tested several of these "folk" methods; fingernail polish, petroleum jelly, a glowing hot match and 70% isopropanol for their ability to induce ticks to "back out" or release from the host. He found that none of these methods initiated self detachment in adult lone star or American dog ticks. Confirmation of the failure of these methods was recently published. More modern "emergency" methods have also been tested. Injection of local anesthetics (lidocaine, lidocaine with epinephrine, and chloroprocaine) also failed to initiate self-detachment. While there are chemicals that will initiate self-detachment, health risks are associated with the use of these chemicals and should not be used.

Conclusion

Timely detection and removal are the most important factors in avoiding tick-borne diseases. Quick methods are therefore essential. At least three new and novel tick removal devices are available to the general public that could serve this role. This laboratory study evaluated their worthiness for safe removal. Although our criteria failed to distinguish the use of one tool above the others, all three were effective for deeply- and superficially-attached adult and nymphal ticks. Each of the three volunteers subjectively preferred a different tool. If one tool feels better in the hands of the user it will most likely perform better. We advocate immediate removal using any of the three commercial tools over medium-tipped tweezers since tweezers were ineffective for

removing nymphs. The following guidelines should be followed during tick removal.

1. Avoid handling ticks with uncovered fingers; use tweezers or commercial tools designed for removal. If index finger and thumb must be used, protect them with rubber gloves, plastic or even a paper towel.
2. Place the tips of tweezers or edges of other removal devices around the area where the mouthparts enter the skin.
3. With steady slow motion, pull the tick away from the skin or slide the removal device along the skin (read the directions for each commercial tool). Do not jerk, crush, squeeze or puncture the tick.
4. After removal, place the tick directly into a sealable container. Disinfect the area around the bite site using standard procedures.
5. Keep the tick alive for a month in case symptoms of a tick-borne disease develop. Place it in a labeled (date, patient), sealed bag or vial with a lightly moistened paper towel then store at refrigerator temperature.

Questions or use of material -- contact: needham.1@osu.edu

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