

Removal of ticks: a review of the literature

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Eurosurveillance recently reported that travellers who discover ticks attached to them should remove the tick by grasping the mouthpiece with tweezers (forceps) and rotating the tick whilst withdrawing it [1]. Subsequently, readers and a posting to *ProMED-mail* [2] have pointed out that other guidelines, including those of the World Health Organization [3] and the United States' Centers for Disease Control and Prevention [4] do not advise rotating the tick during removal. Yet these guidelines also differ from one another with respect to whether it is advisable to suffocate ticks with paraffin or equivalent. Reasons behind the differing advice and some basic common points shared by all guidance are discussed below.

Anatomy and physiology of feeding ticks

Ticks are arthropod vectors of a number of pathogens that cause potentially serious human diseases such as Lyme borreliosis, Rocky Mountain spotted fever, tickborne encephalitis, tularaemia and Q fever. A single tick can carry a number of different pathogens [5], leading to atypical presentation of tickborne illness.

Two classes of tick are responsible for disease in humans, hard ticks (family *Ixodidae*) and soft ticks (family *Argasidae*), the principle difference being the hard plate or scutum that hard ticks possess. There is a third class of tick, family *Nutalliellidae*, of which only one species is known, which is not of medical importance [6]. Because soft ticks take smaller, quicker blood meals at shorter intervals, they can transmit pathogens much more quickly (within a minute of biting) than hard ticks (hours or days) [6]. However, hard ticks are more common, harder to remove and more likely to transmit disease.

Ticks have a barbed, harpoon-like mouthpiece called a hypostome which they insert into their host to suck blood. Many hard ticks also secrete a cement which further strengthens their attachment. When removing ticks, it is important not to squash the body (which could inject toxins or microbes into the host), break off the mouthpiece or leave cement behind (which could lead to allergic irritation from tick proteins or secondary bacterial infection).

Experimental evidence for tick removal techniques

There is very limited experimental evidence to support most suggested tick removal strategies, and only a few reviews [7,8]. While both mechanical removal and chemical incapacitation have their advocates, experimental evidence suggests that chemical irritants are ineffective at persuading ticks to detach, and risk triggering injection of salivary fluids and possible transmission of disease-causing microbes. In addition, suffocating ticks by smothering them with petroleum jelly is an ineffective method of killing them because they have such a low respiratory rate (only requiring 3-15 breaths per hour) that by the time they die, there may have been sufficient time for pathogens to be transmitted.

One study compared several different techniques for removing ticks [9]. Application of petroleum jelly, fingernail polish, 70% isopropyl alcohol, or a hot kitchen match failed to induce detachment of adult American dog ticks (*Dermacentor variabilis*). Using forceps or grasping with fingers as close to the skin as possible did remove the ticks. Rotating the tick during removal did not appear more likely to damage the mouthparts than pulling straight out, though twisting the tick was ultimately not recommended, because of the risk of breaking of the mouthparts.

Three commercially available devices were compared to conventional forceps for their effectiveness in removing lone star (*Amblyomma americanum* (L.)) or American dog ticks (*D. variabilis*) from laboratory rabbits [10]. It was found that for adult ticks, forceps and a commercial product that grasped the tick were superior to products with a central V-shaped groove that were designed to scoop the tick off. Conversely, removal of nymphs (immature ticks) with forceps tended to leave the mouthparts behind more often than removal with the grooved devices. A variety of other techniques were tested, including fingernail polish,

petroleum jelly, a glowing hot match, 70% isopropanol and injection of local anaesthetics (lidocaine, lidocaine with epinephrine, and chloroprocaine). None of these methods initiated self-detachment.

A Spanish study that compared the outcomes of people who removed ticks using forceps and those who used other methods found that people who used forceps were significantly less likely to experience complications, including the skin disease erythema migrans* and secondary bacterial infections [11].

A Dutch study compared the ease of removal and retention of mouthparts using several techniques: applying gasoline, 70% isopropyl alcohol or a hot match, pulling clockwise or pulling straight out with quick or steady even pressure using conventional forceps or 'Tick Solution' forceps [12]. Chemical methods failed to cause ticks to detach within half an hour, and pulling the ticks straight out was significantly less likely to lead to retained mouthparts than rotational pulling. An American study compared conventional forceps against 'Tick Solution' forceps and found the conventional forceps to be superior [13].

Nevertheless, at least one company specifically markets a veterinary product that catches the tick in a groove in a plastic device that is then rotated several times. It claims that the rostrum spikes fold into the axis of rotation, facilitating tick removal without the risk of snapping off the hypostome, and provides video evidence of this technique working on the company's website [14].

Other mechanical techniques have been described, with anecdotal levels of evidence. Lassoing the tick as close to the skin as possible, using a loose knot of cotton thread, such as from clothing, then applying gentle traction, can remove ticks when forceps are not available [15]. Disposable razors have also been suggested [16].

Summary

Relatively few studies have been conducted in this area, and those that have been vary with respect to different tick species, different host species and different time periods of tick attachment before removal. When the species of tick is known to be of the soft family, and disease in humans is not endemic in an area, the World Health Organization recommendation of chemical methods of removing ticks may be appropriate [3]. However, since many people, particularly travellers who are not familiar with an area, will not be able to distinguish between different types of tick or know the local prevalence of disease, it seems sensible to recommend always removing ticks by grasping with forceps as close to the skin as possible and pulling straight out to avoid leaving mouthparts behind. There is a clear and simple image that illustrates this at reference 4.

***Correction.** This was corrected from 'larva migrans' to 'erythema migrans' at the author's request on 18 August 2006
Eurosurveillance editorial office, 18 August 2006.

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