

Investigation of Morphological Characteristics of Pubic lice (*Pthirus pubis*, Linnaeus, 1758)

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ABSTRACT

Pubic lice (*Pthirus pubis*) are obligate, permanent ectoparasites of humans, entirely dependent upon their vertebrate hosts for survival. Pubic lice have a very simplified body form as a result of their parasitic characteristics, being wingless and dorsoventrally flattened. In the study, the pubic lice taken from a male patient were examined morphologically in detail and their taxonomic characteristics were presented. The lice specimens were examined for morphological and taxonomic characteristics under a light microscope. The identification of the *Pthirus pubis* species was made by determining the height, anatomical body parts, dorsal and ventral morphological details of the adult male and female two pubic lice. Examined adult pubic lice were light cream-colored, 1-2 mm in length, and their anatomical structures included three pairs of legs, two prominent antennae, and parts of the thorax and abdomen in a combined structure. *Pthirus pubis* causes pediculosis pubis disease in humans. The disease can be sexually transmitted to humans. *Pthirus pubis* is spread primarily through person-to-person sexual contact. Pubic louse is a major public health problem that can be contagious among humans, and it has great importance to know their morphological characters to diagnose this ectoparasite and distinguish it from other insects.

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Kasık bitlerinin Morfolojik Özelliklerinin İncelenmesi (*Pthirus pubis*, Linnaeus, 1758)

ÖZET

Kasık bitleri (*Pthirus pubis*) hayatta kalmak için omurgalı konakçılara bağımlı, obligat ve daimi insan ektoparazitleridir. Kasık bitleri, kanatsız, dorsoventral olarak düz şekilli ve parazitik özelliklerinden dolayı çok basit yapıdırlar. Çalışmada, erkek bir hastadan alınan kasık bitlerinin ayrıntılı olarak morfolojik ve taksonomik özellikleri incelenerek sunulmuştur. Bit örnekleri morfolojik ve taksonomik özellikler açısından ışık mikroskobu ile incelendi. *Pthirus pubis* türünün tanımlanması, yetişkin erkek ve dişi iki kasık bitinin boyu, anatomik vücut bölümleri, dorsal ve ventral morfolojik detayları belirlenerek yapıldı. İncelenen erişkin kasık bitleri; açık krem renkli, boyları 1-2 mm aralığında, anatomik yapıları ise üç çift bacakları, iki belirgin anten taşıyan baş kısımları ile birleşik yapıdaki thorax ve abdomen bölümleri mevcut idi. *Pthirus pubis*, insanlarda pediculosis pubis hastalığına neden olur. Hastalık cinsel yolla insanlara bulaşmaktadır. Bu hastalık öncelikle kişiden kişiye cinsel ilişki yoluyla yayılmaktadır. Kasık bitleri insanlar arasında bulaşıcı olabilen önemli bir halk sağlığı sorunu olup, bu ektoparazitinin tanısı ve diğer böceklerden ayırt edilmesi için morfolojik karakterlerinin bilinmesi büyük önem taşımaktadır

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INTRODUCTION

Pubic lice (*Pthirus pubis*) are obligate blood-feeding

ectoparasites of humans. The parasite causes pediculosis pubis (also known as *phthiriasis pubis*). The parasitic infection can be transmitted by sexual

contact, close body contact or, less commonly, by touching infested toilet seats, sofas, towels, and bed linen. *P. pubis* infests hairs in the pubic, perianal areas and occasionally other body areas that contain terminal hairs (Salavastru et al., 2017; Light et al., 2010). Morphological properties carry great importance in the taxonomy of Pubic lice. By distinguishing lice species from each other, taxonomic and morphological characterization should be done to make scientific identification. For this purpose; taxonomy categories are determined by examining morphometric measurement of body parts, color, detailed anatomical features, and genital organs. Other characteristics that are most commonly used in diagnosis after morphological characteristics are the physiological and chromosomal structures of the insect and its ecological characters such as host, nutrition, and habitat (Light et al., 2008; Palanisamy et al., 2015). Among the class Insecta, there are about 5000 lice species identified in the order Phthiraptera, of which more than 550 species are reported to live as parasites in mammals (Bonilla et al., 2013). The order Phthiraptera is divided into two main groups, sucking lice and chewing lice. The suborder Anoplura (sucking lice) infest mammalian animals. Of these lice, the species that settle only in humans as hosts are *Pthirus pubis* in the family Pthiridae of the suborder Anoplura, and *Pediculus humanus* (body lice) in the family Pediculidae (Durden et al., 2020; Pakeer et al., 2007; Nuttall, 1918).

It is noted that the spread of pubic lice among humans is usually through sexual contact and does not carry the epidemic typhus unlike body lice (*Pediculus humanus*) (Burkhart and Burkhart, 1999). In Linnaeus taxonomy (Table 1), they are also called Crab louse besides their scientific taxonomy, because the morphological images of pubic lice whose binominal identification has been done resemble crabs. There are two species of pubic lice, one of which is *Pthirus pubis* whose host is human, and the other is *Pthirus gorilla* which infests gorillas, a herbivorous monkey subspecies (Weiss, 2009). In the study, the morphological characteristics of *Pthirus pubis*, which is common all over the world and known as Pubic lice in humans, were determined and diagnosed.

Table 1. Linnaeus taxonomy of Pubic lice (Nuttall, 1918).

Çizelge 1. Kasık bitinin Linnaeus taksonomisi

Kingdom;	Animalia
Phylum;	Arthropoda
Class;	Insecta
Order;	Phthiraptera
Suborder;	Anoplura
Family;	Pthiridae
Genus;	Pthirus
Species;	<i>P. pubis</i>
Binominal name;	<i>Pthirus pubis</i>

MATERIALS and METHOD

Studied material and Sampling procedure

In the study, the patient from whom parasite samples were taken was a 23-year-old male admitting to Kahramanmaraş Sütçü Imam University-Faculty of Medicine Research and Practice Hospital-Infection Outpatient clinic on 29.05.2019 with complaints of severe itching, erythema, and redness in the inguinal and femoral areas during two weeks. It was determined that the patient was married and engaged in animal husbandry and lived in the town of Kale, which is located in the rural area of Kahramanmaraş province, Turkey. It was found that the patient did not have a similar disease condition in his family history, and also that the patient did not have an additional medical problem. As the material of the study, ectoparasite samples that were seen to be alive in the inguinal and femoral areas of the patient were placed in tubes containing 70% ethanol and examined in the Medical Parasitology Laboratory. Samples that were then cleaned of surface residues with potassium hydroxide were prepared for light microscopy (Shakya et al., 2018).

Diagnosing pubic lice

In the preliminary diagnosis of the disease, pediculosis was considered with clinical signs, lesions, and the presence of the parasite in the inguinal area. It was seen that the ectoparasites in the sample were morphologically the same insects. The taxonomic-morphological characteristics of two adult pubic lice which were male and female and randomly selected from these samples were studied under a light microscope (Pakeer et al., 2007; Dehghani et al., 2013).

RESULTS and DISCUSSION

In adult males and females of *P. pubis*, the body structures, which have two antennae and three pairs of legs, consist of 3 parts: caput, thorax, and abdomen. They have no wing structures, but head structures and antennae are prominent. In their morphology, which is bilaterally symmetrical, the thorax and abdomen are not distinctly separated, and they have a dorsoventrally flat body structure (Figure 1-2). The body colors are pale yellow and grey. *P. pubis* are smaller, less mobile and less pigmented than the other lice species, thus more difficult to observe with naked eye (Scanni, 2012). Pubic lice are smaller in structure (1-2mm) than head and body lice, and males are always smaller than females. The pubic lice we examined were light cream colored and their length was 1.2 mm in the adult male and 2 mm in the adult female (Figure 1-2).



Figure 1. a. Dorsal view of adult male *Pthirus pubis*, b. Ventral view of adult female *Pthirus pubis*, Light microscope (x40 magnification)

Şekil 1. a. Erişkin erkek *Pthirus pubis*'in dorsal görüntüsü, b. Erişkin Dişi *Pthirus pubis*' in ventral görüntüsü, Işık mikroskobu (x40 büyütme)

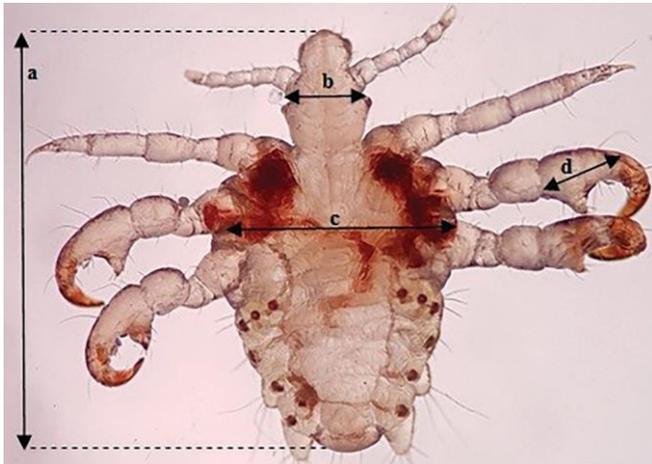


Figure 2. Dorsal view of adult male *Pthirus pubis*, Light microscope (x40 magnification), a. Total body length (1.2 mm), b. Head and postantennal head width c. Thorax ve posterior pterothoracic width, d. II. Extremity, Tibial length, e. Abdomen

Şekil 2. Erişkin erkek *Pthirus pubis*'in dorsal görüntüsü, Işık mikroskobu (x40 büyütme) a. Total vücut uzunluğu (1.2 mm), b. Baş ve postantennal baş genişliği, c. Thorax ve posterior terothoracic genişlik, d. II. Bacak Tibial uzunluk e. Abdomen

Head, mouth, and antenna structures

In adult pubic lice, the caput parts sit on the basis capituli and are clearly visible on top on microscopic examination. The caput is small in comparison to its large pincer-shaped legs and broad oval morphology (Figure 2b-d). Pubic lice are solenophagic insects (that feed on blood) and feed directly by sucking blood from blood vessels located in the pubic hair follicles of the host (Light et al., 2010). The mouth structures, which are the feeding organ, differ from other parasitic insects. The mandible is undeveloped and does not have specialized organs such as palps, chelicera or hypostome for feeding in the oral

structures. Instead, the maxillary structure and labrum (upper lip) organize and turn into a nasal-like structure called the haustellum (Figure 3a).

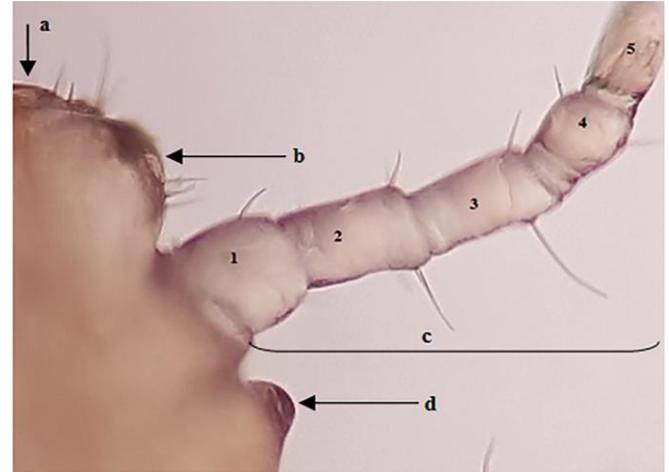


Figure 3. Cranial (head) view of adult *Pthirus pubis*, Light microscope (x100 magnification) a. Labrum, b. Dorsal anterior plate, c. Antennae (1-5;5 segments, filiform structure), d. Eye

Şekil 3. Erişkin *Pthirus pubis*'in cranial (baş) görüntüsü, Işık mikroskobu (x100 büyütme) a. Labrum, b. Dorsal anterior plate, c. Anten (1-5;5 segmentli filiform yapısı), d. Göz

At the entrance of the haustellum are sharp and anchor-like pre-stomal structures called “stylet” derived from the hypopharynx to be able to absorb blood by reaching the blood vessels. The hypopharynx, on the other hand, produces salivary secretions and provides the passage of food into the digestive tract (Mathison and Pritt, 2014; Durden and John, 2009; Kraus and Glassman, 1976).

Antennae are vital organs for the life of insects, and structurally they are very important in taxonomy. *P. pubis* has two antennae on the sides of its head, and these antennae have a 5-segment filiform structure (Figure 3c). In addition to adult pubic lice, an antenna can be found in nymph forms. If antenna structures are examined in detail, the first segment is the pedestal segment and is called “Scapus”. The second segment of the antennae is called the “Pedicellum” and connects the pedestal segment to other flagella segments. The 3rd, 4th, and 5th segments of the antennae consist of flagella parts in movable structure (Figure 3c). The antenna segments of the pubic lice are thin and similar to each other in the form of filament and they have a filiform antenna structure. The antenna structure in males may be larger than in females. On the surface of the antennae, there are special blisters that smell, such as feathers, hairs, and papillae, which can transmit various senses. The eyes and antennae of pubic lice, which are organized on both sides of their heads in a simple structure, serve as a biosensor organ in the

natural habitats of these insects and play a role in receiving chemical and physical stimuli (Ortega et al., 2019; Khan, 2018). Figure 3 c-d shows the eyes of pubic lice and the feathers and hairs located above the antenna segments.

Extremity and thorax structures

Adult *P. pubis* has a total of six legs. All three pairs of legs have a 5-part structure: coxa, trochanter, femur, tibia, and tarsus. The tarsus part ends with a thin claw tip on the first leg, but on the other two pairs of legs, the pretarsal claw tip and the distal tip of the tibia are pincers-shaped and large (Figure 4). Pubic lice have a strong grip on people's pubic hair thanks to these leg shapes. The first pair of legs is different

from the other two legs, and the structures of the femur, tibia, and tarsus are thinner. Due to their oval-shaped morphology and large pincer-shaped leg structure of pubic lice, these lice are also called "crab louse" (Khan, 2018; Opaneye et al., 1993; Saddozai and Kakarsulemankhel, 2008).

Thorax consists of three segments. The first of these, the one in front, is called prothorax, and the one in the middle is called mesothorax, and the one in the back is called metathorax (Figure 4). In pubic lice, these three segments are fused with each other (Burgess and Cowan 1993). As a general structure, from each segment of the chest comes a pair of legs starting with the coxa (Figure 4).

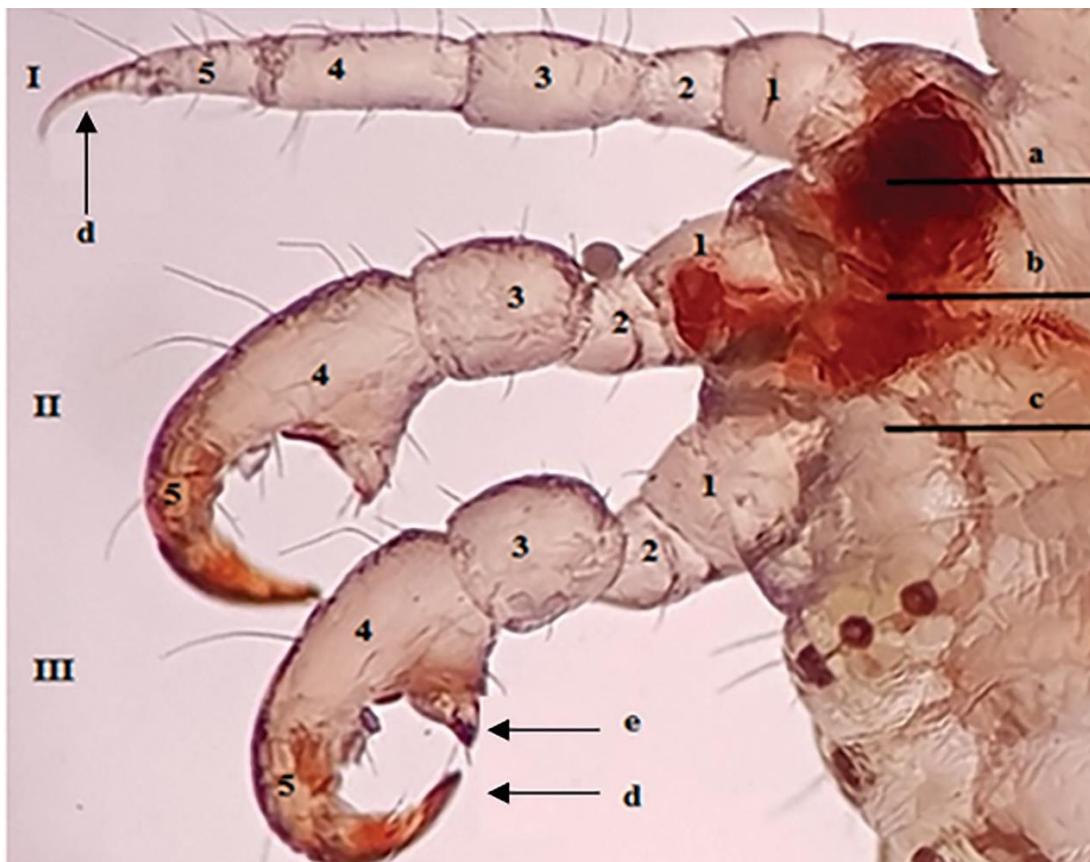


Figure 4. Extremity and thorax view of adult *Pthirus pubis*, Light microscope (x40 magnification), Thorax: a. Prothorax; b. Mesothorax; c. Metathorax, Extremiteler: I, II, III.; 1. Coxa; 2. Trochanter; 3. Femur; 4. Tibia; 5. Tarsus; d. Pretarsal claw; e. Distal tibial spine

Şekil 4. Erişkin *Pthirus pubis*'in extremiteler ve thorax görüntüsü, Işık mikroskobu (x40 büyütme), Thorax: a. Prothorax; b. Mesothorax; c. Metathorax, Extremiteler (Bacaklar): I, II, III.; 1. Coxa; 2. Trochanter; 3. Femur; 4. Tibia; 5. Tarsus; d. Pretarsal claw; e. Distal tibial spine

Abdominal structures

In the abdomen, which is one of the posterior body parts of pubic lice, there are intestines, reproductive organs, and other structures. If we examine these structures; tubercles located in the ventrolateral of the abdomen (Lateral tubercle, Figure 5) are hump-shaped protrusions of the body wall of the lice

towards the sides, which are hardened and sclerotized plates (Mathison and Pritt, 2014; Lee et al., 1990). The female pubic lice we examined had four pairs of lateral tubercles that were more pronounced compared to the male.

Respiratory systems of pubic lice comprise the stigma (respiratory opening) and trachea (tubule) (Figure 5-

A1 and B6). It is engaged to the stigmas located on the sides of the abdominal segments and the tracheas in the form of branched tangles. The stigmas, which serve as a breathing hole, are surrounded by a thick layer of chitin and have the form of a circular cap, which is managed by muscles. Lice can open and close their stigma voluntarily. Respiration function is fulfilled by this tracheal system as a result of muscle contractions and expansion of the body wall (Opaneye

et al., 1993; Roberts, and Janovy, 2009).

In pubic lice, the abdominal structure is short and wide compared to head and body lice, and usually, the segments are not obvious and are fused with each other (Figure 5). On the backside of the abdomen are the anus and genital organs (Figure 5A,B-3). In pubic lice, the digestive system begins with the mouth and continues with the stomach and intestines, consisting of cecum, and ends with the anus.

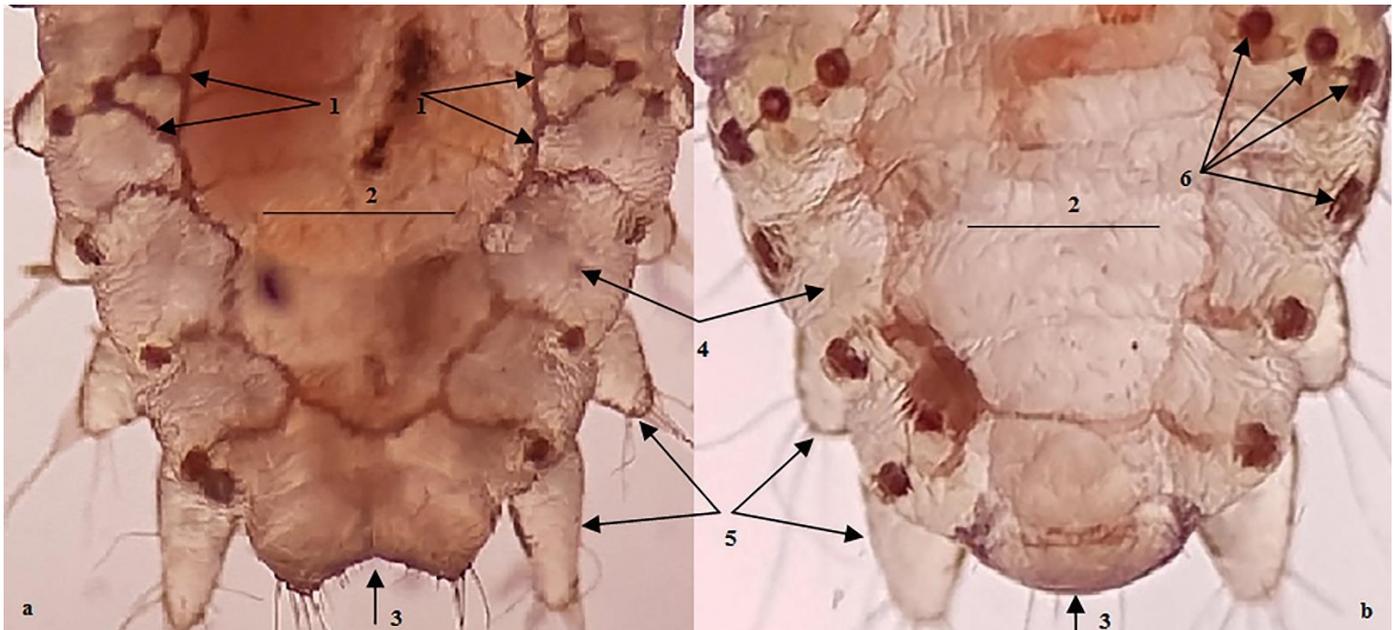


Figure 5. A. Dorsal view of adult female *Pthirus pubis*, B. Dorsal view of adult male *Pthirus pubis*, A 1. Abdominal trachea; A,B 2. Abdominal segment; A,B 3. Genital opening, anus; A,B 4. Abdominal sternite; A,B 5. Lateral tubercle; B 6: Abdominal Dorsal Stigma (spiralce)

Şekil 5. A. Erişkin Dişi *Pthirus pubis*' in dorsal görüntüsü. B. Erişkin Erkek *Pthirus pubis*' in dorsal görüntüsü. A 1. Abdominal trachea; A,B 2. Abdominal segment; A,B 3. Genital açıklık, anüs; A,B 4. Abdominal sternit; A,B 5. Lateral tubercle; B 6: Abdominal Dorsal Stigma'lar (spiralce)

Metamorphosis and physiological properties of pubic lice

The habitats of pubic lice have large cosmopolitan biogeography (habitat kaynağı), including nearctic, paleartic and neotropical areas. *P. pubis* species, which have a wide distribution around the world as habitat, specifically only host humans. These blood-fed lice are ectothermic and hemimetabola insects due to their physiological structure, and their development occurs in three stages in the form of eggs, nymphs (young lice) and adults. Young pubic lice pass through three nymph stages, reaching sexual maturity after about 23 days and turning into adult lice. The life span of pubic lice is about one month. Morphologies of nymphs and adult pubic lice are similar (Burkhart and Burkhart, 1999; Durden and John, 2009). In the study, the taxonomy of adult males and females is examined because they are larger and more prominent. Pubic lice can live no more than 24 hours when they leave their host. Pubic

lice, which can reproduce throughout the year, show a dioecious (separate sex) sexual dimorphism. Reproduction occurs sexually through the reproductive organs (Figure 5 A,B-3) in the genital opening of male and female lice, and the gestation period of females is 6-8 days. At the end of pregnancy, a female lays about 30 eggs on hairs in the pubic and perianal region of people, and less on axilla, chest hair, beard, eyelashes, and eyebrows. Eggs that stick to the hairs are called nits. Female pubic lice leave their eggs after providing nutrients to them (Altınsoy et al., 2018; Roberts and Janovy, 2009).

The parasitic infestation of pubic lice

As an ectoparasite, *P. pubis* infestations affect 1-2% of the world's population. It is reported that infestation is mostly seen in unhygienic places with high population density and in sexually active individuals aged 15-45 (Wu et al., 2000). In the study, the patient we took lice samples from was 22 years old and

sexually active. The area where the patient lived was a rural area and he was dealing with sheep and goat breeding. However, pubic lice are not a zoonotic parasite, and disease sources have not been associated with his occupation. With the anamnesis information obtained from the patient, it could not be understood how pubic lice were transmitted.

P. pubis, which can infrequently settle on the eyebrows and eyelashes, can lead to the symptoms of pitriasis palpebrarum, characterized by severe itching in the eyelids. In the case we took samples from, lice only settled in the pubic and perianal region. In inguinal lice, the infectious stage is observed in adults and can be transmitted from person to person, mostly through sexual contact, less through clothing, contaminated toilets, and beds (Anderson and Chaney 2009). In different studies, it has been shown that pubic lice can be transmitted between family members, not only between spouses but also especially young children who are in close contact with their parents, by settling on the eyelids and clinically leading to pitriasis palpebrarum (Veraldi et al., 2009; Altınsoy et al., 2018). In the study, the wife and children of the clinical case that we evaluated did not have a history of the disease. *P. pubis* is less mobile (10 cm/day) than other species of lice (head-body lice, 23 cm/min) and can stay on human skin for days by clinging tightly to the host skin and hair with its crab-like strong claws and mouth organelle (Burkhart, 2003).

CONCLUSION

Consequently, pubic lice lead to superficial and local clinical symptoms in the areas of the body where they settle in the host but do not transmit pathogenic bacteria. In parasitic infestations that develop with these lice, clinical samples should be taken and studied parasitologically and the correct diagnosis should be made by determining the morphological characteristics of lice.

Statement of Conflict of Interest

Authors have declared no conflict of interest.

Author's Contributions

The contribution of the authors is equal.

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