

Contagious Ecthyma

Orf, Ecthyma Contagiosum, Contagious Pustular Dermatitis, Contagious Pustular Stomatitis, Infectious Labial Dermatitis, Soremouth, Scabby Mouth

Last Updated: August 2023



IOWA STATE UNIVERSITY
College of Veterinary Medicine



Importance

Contagious ecthyma, also known as orf, is a zoonotic viral skin disease that affects sheep, goats and some other domesticated and wild animals. The lesions are painful and often occur on the mouth and muzzle, where they can cause reduced appetite or anorexia. Lesions on the teats may result in the abandonment of offspring, and foot lesions can cause transient lameness. Although contagious ecthyma usually resolves spontaneously, and mortality is low when animals receive adequate supportive care, deaths can occur from sequelae such as secondary infections or failure to nurse, and more extensive lesions, including some that extend into internal organs, have been described. The economic impact of this disease can be significant even when the lesions are relatively mild.

Most infections in humans are limited to one to a few nodules and heal spontaneously; however, large, poorly healing lesions have been seen occasionally, mainly in people who are immunosuppressed.

Etiology

Contagious ecthyma is caused by orf virus, a member of the genus *Parapoxvirus* in the subfamily Chordopoxvirinae and family Poxviridae. Four other parapoxviruses - bovine papular stomatitis virus, pseudocowpox virus, grey sealpox virus and red deerpox virus - have been officially recognized as of 2022, and an additional virus closely related to pseudocowpox virus, termed camel contagious ecthyma virus, has been proposed. Some authors have suggested that other parapoxviruses causing contagious ecthyma in species other than sheep or goats might also be distinct viruses.

Species Affected

Contagious ecthyma affects sheep, goats and their wild relatives (subfamily Caprinae) such as muskoxen (*Ovibos moschatus*), Japanese serows (*Capricornis crispus*), bighorn sheep (*Ovis canadensis*), mountain goats (*Oreamnos americanus*), Dall's sheep (*Ovis dalli dalli*), Sichuan takin (*Budorcas taxicolor tibetana*), tahr (*Hemitragus* spp.), Alpine ibex/ steinbok (*Capra ibex*) and possibly chamois (*Rupicapra rupicapra*). It has also been reported in other domesticated and wild mammals including alpacas, pronghorn (*Antilocapra americana*), blackbuck (*Antilope cervicapra*) and some cervids including reindeer/ caribou (*Rangifer tarandus*) and deer in the genus *Odocoileus*. A few recent outbreaks of skin disease among cattle in Turkey were attributed to orf virus rather than cattle parapoxviruses, based on PCR, and rare cases have been documented in cats and dogs. Rabbits and mice can be infected experimentally. A similar disease in camels is now mostly attributed to camel contagious ecthyma virus; however, some cases might be caused by orf virus.

Zoonotic potential

Orf virus is zoonotic.

Geographic Distribution

Contagious ecthyma has been identified in most countries that raise small ruminants, and is likely to be present wherever sheep and goats are found.

Transmission

Orf virus, which can be found in skin and mucosal lesions, including scabs, is thought to enter the skin through cuts and abrasions. Many cases are thought to be acquired during grazing or via contaminated feed, and infected offspring can transmit the virus to their dam's teats when nursing. The virus is reported to remain viable on wool and hides for approximately a month after the lesions have healed. Orf virus is very resistant to inactivation in the environment, and it has been recovered from dried crusts for several months or years in the laboratory, with one account of survival for up to 12 years. Survival may be shorter in wet conditions.

Humans can become infected by contact with infected animals and their tissues, or from viruses on fomites. One probable case occurred after a scratch from a kitten, in a person who had no contact with livestock. Contagious ecthyma vaccines, which contain live virus, can also cause lesions. Person-to-person transmission has reported in very

rare instances. This usually seems to occur during close contact (e.g., parent to child), but there is one report of transmission within a family via shared tweezers. Nosocomial transmission was responsible for an outbreak in a burn ward.

Disinfection

One study found that sodium hypochlorite and two quaternary ammonium-based commercial disinfectants were effective against orf virus, but ethanol was ineffective. Other disinfectants that have been suggested for poxviruses include detergents, alkalis, Virkon® and glutaraldehyde. In an early study, orf virus was inactivated by heating at 59°C (138°F) for 30 minutes.

Infections in Animals

Incubation Period

Contagious ecthyma lesions usually develop within a few days of exposure.

Clinical Signs

Small ruminants and other ungulates

Contagious ecthyma, which sometimes affects the mucous membranes as well as the skin, varies in severity from hyperemia and small pustules around the mouth and muzzle to extensive proliferative and exudative lesions in multiple locations. The lesions begin as macules and papules and evolve into pustules and vesicles and, in some instances, nodular or papillomatous growths, before becoming covered with thick brown scabs. The scabs which are often friable and bleed easily, can sometimes cover extensive areas of granulation, inflammation and ulceration. Eventually they dry and fall off, and the skin usually heals without scarring, generally within a few weeks to 2 months of disease onset. The most commonly affected sites are the muzzle, mouth and nose, but lesions may also occur on the ears, eyelids, feet (typically around the fetlock or coronet), teats and udder, perineal region/ genitalia or other sites (e.g., the tail after docking). Oral mucous membranes are sometimes affected, particularly in young animals, and some reindeer were reported to have oral lesions with no apparent cutaneous involvement. Rarely, mucosal lesions may extend into the gastrointestinal or respiratory tracts. Unusually, proliferative nodules and scabs found mainly on the back and legs of cattle were reported to have orf virus DNA during some outbreaks in Turkey.

Pain from contagious ecthyma lesions can result in reduced appetite with loss of condition or even starvation, abandonment of offspring (teat lesions) and/or lameness. Secondary bacterial infections (including *Dermatophilus congolensis* on the feet), and maggot or screwworm infestations are also possible, and lesions on the teats may predispose animals to mastitis. Persistent severe proliferative dermatitis has been reported rarely.

Contagious ecthyma in nonruminants

One published report described three cases of contagious ecthyma affecting the feet of cats exposed to infected small ruminants. One cat had a red, friable lesion with a cauliflower-like appearance, while the other two cases were described as proliferative, ulcerated lesions either on or between the digits. The lesions recurred locally after excision and/or amputation of the affected digit, and resulted in eventual euthanasia of all three animals. There is also a report of a cat with multiple scabs on the face and back, which healed within 2 weeks and were associated with a parapox-like virus; however, the identity of the virus in this case is uncertain.

Contagious ecthyma was also suspected in a pack of dogs that had been periodically fed entire, unskinned carcasses from sheep and other animals, and occurred concurrently with a clinical case of orf in the kennel huntsman. The dogs developed circular areas of acute, most dermatitis with ulcers and scabs, mainly around the head. The outcome was not described.

Experimentally infected rabbits had mild to moderate skin lesions of self-limited local erythema, macules, papules, small vesicles and pustules. Similar but very mild signs were reported in experimentally infected mice.

Post Mortem Lesions [Click to view images](#)

In addition to skin and mucosal lesions, gross lesions may be found rarely in the esophagus, rumen, omasum, lower intestinal tract, heart and respiratory tract. Skin and mucosal lesions may sometimes be accompanied by regional lymphadenopathy.

Diagnostic Tests

Clinical cases in animals are often diagnosed symptomatically. A definitive diagnosis can be made by PCR, and loop-mediated isothermal amplification assays have been published. Although culture is rarely used for diagnosis, orf virus can be isolated in a variety of cell cultures or embryonated eggs, if necessary. This virus grows slowly, and isolation is not always successful. Antigen detection tests that have been described include immunohistochemistry, immunofluorescence and lateral flow immunochromatographic assays. Cross-reactivity with other parapoxviruses may be an issue in some antigen tests.

Electron microscopy of scabs collected from animals in the early stage of the disease can reveal the presence of a parapoxvirus, though it cannot distinguish orf virus from other parapoxviruses. Histopathology is also helpful. Various serological tests including serum neutralization, ELISAs, agar gel immunodiffusion (AGID), complement fixation and agglutination have been described, though antibody titers are generally low and short-lived, and cross-reactions may be a concern.

Treatment

Treatment for contagious ecthyma consists of supportive and symptomatic care, which may include tube

feeding, antibiotics, and fly repellents and/or larvicides, as needed. Novel treatments such as antiviral agents, diathermy and cryosurgery have also been investigated, though they are unlikely to be economical (or necessary) for routine use. Surgical excision alone was unsuccessful for the treatment of nonhealing foot lesions in 3 cats.

Control

Disease reporting

Veterinarians who encounter or suspect contagious ecthyma should consult their national and/or local guidelines for any reporting requirements; however, this disease is very common and unlikely to be reportable in most locations. State regulations should be checked in the U.S.

Prevention

Quarantines of new animals and biosecurity measures to prevent virus introduction on equipment and other fomites can be helpful in uninfected herds. At shows and fairs, exhibitors may prefer to open their own animal's mouth to prevent inadvertent virus transmission between animals on the hands. The removal of harsh vegetation from pastures or feed might help in reducing abrasions around the mouth that facilitate virus entry.

Orf virus is difficult to eradicate once it has entered a flock or herd. Isolation of infected animals may reduce virus spread during outbreaks, and fomites (e.g., troughs and feeders) should be cleaned and disinfected before reuse. Vaccination can reduce the severity and duration of the clinical signs; however, contagious ecthyma vaccines contain live virus, and should be used only on premises where infections have occurred in the past. Recently vaccinated animals should be separated from unvaccinated animals until the vaccination scabs have fallen off.

Morbidity and Mortality

Outbreaks of contagious ecthyma may occur annually on infected premises, but older animals usually have some degree of immunity and may either be resistant to lesions or develop smaller lesions that resolve more quickly. Initial exposure can result in up to 70% morbidity in a naive flock, but animals < 1 year of age are most severely affected in subsequent outbreaks. While the case fatality rate is usually < 1% in uncomplicated cases, it can be significantly higher when there are untreated secondary bacterial infections, arthropod infestations (e.g., maggots, screwworms) or complications from anorexia. Stressors such as concurrent illnesses, malnutrition or poor management can increase the severity of the clinical signs. More virulent virus strains and enhanced breed (e.g., Boer goats) and/or individual susceptibility have also been suggested as possible contributory factors in some severe outbreaks.

Very few clinical cases have been documented in cats or dogs, and one attempt to inoculate cats experimentally in 1923 was unsuccessful, suggesting that they might not be very susceptible to orf virus. Three cases reported in cats could not be cured by excision and resulted in euthanasia; however, it is

possible that these cats were unusually susceptible and most cases in carnivores as so mild that they go unnoticed.

Infections in Humans

Incubation Period

The incubation period in humans is approximately 3-7 days.

Clinical Signs

Contagious ecthyma in people is usually limited to one to a few lesions at the site of exposure, often a finger or hand, which typically resolve spontaneously within a month or two. Initially, a macular lesion develops into a small, firm, red to blue papule, then a hemorrhagic pustule or bulla (targetoid stage), and subsequently a reddish nodule, which may weep fluid and often becomes papillomatous as it dries. The targetoid lesion is considered to be most characteristic stage, with a red or necrotic center or central crust that is surrounded by a white ring and red outer halo. In the final stage, the nodule becomes covered by a thick, dry crust as the lesion resolves. Contagious ecthyma lesions are sometimes accompanied by a low grade fever, which typically lasts only a few days, or by mild lymphadenopathy. Secondary infections are the most frequent complication, but hypersensitivity reactions (e.g., erythema multiforme) have also been reported.

Occasional reports of atypical cases include patients with multiple lesions at one or more sites (which may sometimes result from autoinoculation); cases with a pruritic vesiculopapular rash; rare eye (conjunctival) involvement; and single large lesions refractory to treatment, a condition that is sometimes termed giant orf. Giant orf most often affects people who are immunosuppressed, and generally appears as a several centimeter granulomatous, vascular and friable tumor, which may be pedunculated. A nosocomial outbreak among burn patients was characterized by granulation tissue in some patients, as well as papules that progressed to pustules, weeping nodules and crusted lesions. These lesions only affected the burn sites and autologous skin grafts, and spared intact skin, and were sometimes accompanied by fever and lymphadenopathy. Two of 13 patients died during this outbreak, but the contribution of the orf virus to these deaths was unclear.

Diagnostic Tests

Human cases are often diagnosed based on the appearance of the lesions. Diagnostic tests, including PCR, are similar to those used in animals. Virus isolation, serology and tests to detect viral antigens are not ordinarily used for diagnosis, and electron microscopy has generally been replaced by PCR, where available.

Treatment

Only supportive treatment is usually needed in healthy people, as the lesions generally resolve on their own. Local antiseptics, antibiotics and dressings may be used to prevent or treat secondary bacterial infections. Antiviral and/or immunomodulatory agents such as cidofovir, acyclovir,

valacyclovir, imiquimod and interferon are employed occasionally, usually in immunocompromised patients and/or others with nonhealing or spreading lesions. Other treatments that have been used in refractory cases include cryotherapy or curettage and electrodesiccation. In some reports, superficial curettage alone resulted in the rapid proliferation of large lesions (giant orf) at the margins.

Prevention

Nonporous gloves can protect the skin, particularly broken skin, when handling infected animals, wool, hides, live vaccines and fomites. Gloves should also be considered during contact with asymptomatic small ruminants, especially around the mouth and muzzle. Exposed skin should be washed with soap and water. (A waterless alcohol-based hand rub may be used when soap is not available and hands are not visibly soiled). People who are immunosuppressed should avoid contact with infected animals.

Morbidity and Mortality

Contagious ecthyma is a common occupational disease in people who are in close contact with sheep and goats or their hides and wool. Cases have also been associated with cultural or religious practices that involve slaughtering small ruminants. The incidence of this disease is unclear, as many people recognize the lesions and do not seek medical attention, but some studies have suggested prevalence ranging from < 5% to 30%. Reinfection is possible, but the lesion is usually smaller.

Contagious ecthyma lesions usually resolve spontaneously, though persistent or growing lesions refractory to treatment can be seen occasionally. Most of these cases affect people who are immunosuppressed; however, a few have been reported in healthy people, including children.

Internet Resources

[Agriculture Victoria, Australia. Scabby mouth \(orf\)](#)

[eMedicine.com - Orf](#)

[The Merck Manual](#)

[The Merck Veterinary Manual](#)

Acknowledgements

This factsheet was written by Anna Rovid Spickler, DVM, PhD, Veterinary Specialist from the Center for Food Security and Public Health. The U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS) provided funding for this factsheet through a series of cooperative agreements related to the development of resources for initial accreditation training.

The following format can be used to cite this factsheet. Spickler, Anna Rovid. 2023. *Contagious Ecthyma*. Retrieved from <http://www.cfsph.iastate.edu/DiseaseInfo/factsheets.php>.

References

- Abu EM, Housawi FM. Drastic cutaneous multi-focal orf infection in goats, causing severe dysfunctioning. *Rev Sci Tech*. 2009;28(3):1025-9.
- Abubakr MI, Abu-Elzein EM, Housawi FM, Abdelrahman AO, Fadlallah ME, Nayel MN, Adam AS, Moss S, Forrester NL, Coloyan E, Gameel A, Al-Afaleq AI, Gould EA. Pseudocowpox virus: the etiological agent of contagious ecthyma (Auzdyk) in camels (*Camelus dromedarius*) in the Arabian peninsula. *Vector Borne Zoonotic Dis*. 2007;7(2):257-60.
- Abu Ghazaleh R, Al-Sawalhe M, Abu Odeh I, El Ibrahim J, Al-Turman B, Makhameh J. Host range, severity and transboundary transmission of orf virus (ORFV). *Infect Genet Evol*. 2023;112:105448.
- Acha PN, Szyfres B (Pan American Health Organization [PAHO]). Zoonoses and communicable diseases common to man and animals. Volume 2. Chlamydiosis, rickettsioses, and viroses. 3rd ed. Washington DC: PAHO; 2003. Scientific and Technical Publication No. 580. Contagious ecthyma; p. 80-3.
- Adedeji AJ, Gamawa AA, Chima NC, Ahmed AI. First report of camel contagious ecthyma in Nigeria. *Open Vet J*. 2018;8(2):208-11.
- Agriculture and Resource Management Council of Australia and New Zealand. Australian veterinary emergency plan [AUSVETPLAN], 2nd edition [online]. Operational procedures manual. Decontamination. Commonwealth of Australia; 2000 May. Available at: <http://www.aahc.com.au/ausvetplan/decfnl2.pdf>. * Accessed 11 May 2004.
- Animal Health Australia. National Animal Health Information System (NAHIS). Contagious ecthyma. Available at: <http://www.aahc.com.au/nahis/disease/dislist.asp>. * Accessed 13 Aug 2004.
- Bergqvist C, Kurban M, Abbas O. Orf virus infection. *Rev Med Virol*. 2017;27. doi: 10.1002/rmv.1932.
- Buchan J. Characteristics of orf in a farming community in mid-Wales. *Br Med J*. 1996;313:203-34.
- Cargnelutti JF, Masuda EK, Martins M, Diel DG, Rock DL, Weiblen R, Flores EF. Virological and clinico-pathological features of orf virus infection in experimentally infected rabbits and mice. *Microb Pathog*. 2011;50(1):56-62.
- Centers for Disease Control and Prevention. Orf virus infection in humans--New York, Illinois, California, and Tennessee, 2004-2005. *Morb Mortal Wkly Rep*. 2006;55:65-8.
- Centers for Disease Control and Prevention [CDC]. Orf virus (sore mouth infection) [online]. CDC; 2015 May. Available at: <http://www.cdc.gov/poxvirus/orf-virus/>. Accessed 23 Sept. 2015.
- da Costa RA, Cargnelutti JF, Schild CO, Flores EF, Riet-Correa F, Giannitti F. Outbreak of contagious ecthyma caused by orf virus (*Parapoxvirus ovis*) in a vaccinated sheep flock in Uruguay. *Braz J Microbiol*. 2019;50(2):565-9.
- De la Concha-Bermejillo A, Ermel RW, Zhang MZ, Guo J. Contagious ecthyma (orf) virulence factors and vaccine failure [online]. In: United States Animal Health Association 1999 Proceedings; 1999; 1999 Oct 7-14; San Diego, CA. Available at: <http://www.usaha.org/speeches/speech99/s99conch.html>. * Accessed 28 Sept 2004.
- De la Concha-Bermejillo A, Guo J, Zhang Z, Waldron D. Severe persistent orf in young goats. *Vet Diagn Invest*. 2003;15:423-31.

- de Oliveira CH, Assis FL, Neto JD, Oliveira CM, Lopes CT, Bomjardim Hdos A, Vinhote WM, Silva AG, Abrahão JS, Kroon EG. Multifocal cutaneous orf virus infection in goats in the Amazon region, Brazil. *Vector Borne Zoonotic Dis.* 2012;12(4):336-40.
- Fairley RA, Whelan EM, Pesavento PA, Mercer AA. Recurrent localised cutaneous parapoxvirus infection in three cats. *N Z Vet J.* 2008;56(4):196-201.
- Fenner F, Bachmann PA, Gibbs EPJ, Murphy FA, Studdert MJ, White DO. *Veterinary virology.* San Diego, CA: Academic Press Inc.; 1987.Orf; p. 397.
- Frandsen J, Enslow M, Bowen AR. Orf parapoxvirus infection from a cat scratch. *Dermatol Online J.* 2011;17:9.
- Gallina LI, Scagliarini A. Virucidal efficacy of common disinfectants against orf virus. *Vet Rec.* 2010;166(23):725-6.
- Georgiades G, Katsarou A, Dimitroglou K. Human orf (ecthyma contagiosum). *J Hand Surg.* 2005;30(4):409-11
- Greig AS. Contagious ecthyma of sheep I. Attempts to infect other hosts. *Can J Comp Med Vet Sci.* 1956; 20(12): 448-52.
- Guo J, Rasmussen J, Wunschmann A, de La Concha-Bermejillo A. Genetic characterization of orf viruses isolated from various ruminant species of a zoo. *Vet Microbiol.* 2004;99:81-92.
- Hawayek LH, Rubeiz N. Orf [online]. *eMedicine*; 2007 Jan. Available at: <http://www.emedicine.com/derm/topic605.htm>.* Accessed 16 Apr 2007.
- Hoover AZ. Orf [online]. *eMedicine*; 2018 Jun. Available at: <https://emedicine.medscape.com/article/1133450-overview>. Accessed 7 Aug 2023.
- Hosamani M, Scagliarini A, Bhanuprakash V, McInnes CJ, Singh RK. Orf: an update on current research and future perspectives. *Expert Rev Anti Infect Ther.* 2009;7(7):879-93.
- Housawi FM, Abu Elzein EM, Gameel AA, Alafaleq AI.. A close comparative study on the response of sheep and goats to experimental orf infection. *Zentralbl Veterinarmed B.* 1993;40:272-82.
- Inoshima Y, Ito M, Ishiguro N. Spatial and temporal genetic homogeneity of orf viruses infecting Japanese serows (*Capricornis crispus*). *J Vet Med Sci.* 2010;72(6):701-7.
- Inoshima Y, Takasu M, Ishiguro N. Establishment of an on-site diagnostic procedure for detection of orf virus from oral lesions of Japanese serows (*Capricornis crispus*) by loop-mediated isothermal amplification. *Vet Med Sci.* 2017;78(12):1841-5.
- International Committee on Taxonomy of Viruses [ICTV]. Universal virus database, 2022 release. *Parapoxvirus* [online]. ICTV; 2022. Available at: <https://ictv.global/taxonomy>. Accessed 14 Aug 2023.
- Joseph RH, Haddad FA, Matthews AL, Maroufi A, Monroe B, Reynolds M. Erythema multiforme after orf virus infection: a report of two cases and literature review. *Epidemiol Infect.* 2015;143(2):385-90.
- Kapil S, Yeary T, Evermann JF. Viral diseases of new world camelids. *Vet Clin North Am Food Anim Pract.* 2009;25(2):323-37.
- Kater JC, Hansen NF. Contagious ecthyma in wild thar in the South Island. *N. Zeal Vet J.* 1962;10(5): 116-7.
- Key SJ, Catania J, Mustafa SF, Logan R, Kalaval M, Hodder SC, Patton DW. Unusual presentation of human giant orf (ecthyma contagiosum). *J Craniofac Surg.* 2007;18:1076-8.
- Khalafalla AI, Agab H, Abbas B. An outbreak of contagious ecthyma in camels (*Camelus dromedarius*) in eastern Sudan. *Trop Anim Health Prod.* 1994;26(4):253-4.
- Kitchen M, Müller H, Zobl A, Windisch A, Romani N, Huemer H. Orf virus infection in a hunter in western Austria, presumably transmitted by game. *Acta Derm Venereol.* 2014;94(2):212-4.
- Klein J, Tryland M. Characterisation of parapoxviruses isolated from Norwegian semi-domesticated reindeer (*Rangifer tarandus tarandus*). *Virologia.* 2005;2:79.
- Konig GA, Peralta A. Contagious ecthyma in sheep and goats. In: Winter AL, Moses MA, editors. *The Merck veterinary manual.* Ratham, NJ: Merck and Co; 2023. Available at: <https://www.merckvetmanual.com/integumentary-system/pox-diseases/contagious-ecthyma-in-sheep-and-goats>. Accessed 6 Aug 2023.
- Kuhl JT, Huerter CJ, Hashish H. A case of human orf contracted from a deer. *Cutis.* 2003;71:288-90.
- Li J, Song D, He W, Bao Y, Lu R, Su G, Wang G, Lu H, Zhao K, Gao F. Rapid detection of orf virus by loop-mediated isothermal amplification based on the DNA polymerase gene. *Arch Virol.* 2013;158(4):793-8.
- Lojicic I, Cac Z, Beck A, Bedekovic T, Cvetnic Z, Sostaric B. Phylogenetic analysis of Croatian orf viruses isolated from sheep and goats. *Virologia.* 2010;7:314.
- Martins M, Cargnelutti JF, Weiblen R, Flores EF. Pathogenesis in lambs and sequence analysis of putative virulence genes of Brazilian orf virus isolates. *Vet Microbiol.* 2014;174(1-2):69-77.
- Midilli K, Erkiç A, Kuşkuç M, Analay H, Erkiç S, Benzonana N, Yildirim MS, Mülayim K, Acar H, Ergonul O. Nosocomial outbreak of disseminated orf infection in a burn unit, Gaziantep, Turkey, October to December 2012. *Euro Surveill.* 2013;18(11):20425.
- Opene C, Fung MA, Silverstein M. Orf progressiva: giant progressive and destructive infections in the immunocompromised. *Dermatol Online J.* 2021;27(1):13030/qt97d3k1pr.
- Oryan A, Mosadeghhesari M, Zibae S, Mohammadi A. Identification and phylogenetic analysis of contagious ecthyma virus from camels (*Camelus dromedarius*) in Iran. *Onderstepoort J Vet Res.* 2017;84(1):e1-5.
- Paiba GA, Thomas DR, Morgan KL, Bennett M, Salmon RL, Chalmers R, Kench SM, Coleman TJ, Meadows D, Morgan-Capner P, Softley P, Sillis M, Green LE. Orf (contagious pustular dermatitis) in farmworkers: prevalence and risk factors in three areas of England. *Vet Rec.* 1999;145(1):7-11.
- Pang F, Long Q. Recent advances in diagnostic approaches for orf virus. *Appl Microbiol Biotechnol.* 2023;107(5-6):1515-23.
- Pether JVS, Guerrier CJW, Jones SM, Adam AE, Kingsbury WN. Giant orf in a normal individual. *Br J Dermatol.* 1986;115:497-9.
- Rajkomar V, Hannah M, Coulson IH, Owen CM. A case of human to human transmission of orf between mother and child. *Clin Exp Dermatol.* 2016;41(1):60-3.
- Rørdam OM, Grimstad Ø, Spigset O, Ryggen K. Giant orf with prolonged recovery in a patient with psoriatic arthritis treated with etanercept. *Acta Derm Venereol.* 2013;93(4):487-8.

- Rothenburger JL, Di Francesco J, Leclerc LM, van der Meer F, Tomaselli M, Zabek E, Kutz SJ. *Corynebacterium freneyi* bacterial septicemia secondary to contagious ecthyma in a wild muskox (*Ovibos moschatus*). J Wildl Dis. 2021;57(1):225-9.
- Sharma AK, Venkatesan G, Mathesh K, Ram H, Ramakrishnan MA, Pandey AB. Occurrence and identification of contagious ecthyma in blackbuck. Virusdisease. 2016;27(2):198-202.
- Shehata AA, El-Nahas EM, Abo Hatab EM, Sharawi SSA, Ahmed HA. The genetic identification of camel contagious ecthyma virus as the causative agent of contagious ecthyma in dromedary camels (*Camelus dromedarius*) in Qatar. Trop Anim Health Prod. 2021;53(2):332.
- Smith M, Sherman D. Goat medicine. Pennsylvania: Lea and Febiger; 1994. Contagious ecthyma; p. 22-3.
- Spyrou V, Valiakos G. Orf virus infection in sheep or goats. Vet Microbiol. 2015;181(1-2):178-82.
- State of Alaska. Ecthyma contagiosum - Orf- in musk ox [online]. State of Alaska; 1978 May. Epidemiology bulletin No. 12. Available at: http://www.epi.hss.state.ak.us/bulletins/docs/b1978_12.htm.* [Available by request; no longer available online] Accessed 28 Sept. 2004.
- Tahir M, Dar NR, Mumtaz J, Anwar I, Mustafvi S. Orf with unusual features. J Coll Physicians Surg Pak. 2014;24 Suppl 3:S174-5.
- Thompson HJ, Harview CL, Swick B, Powers JG. Orf virus in humans: case series and clinical review. Cutis. 2022;110(1):48-52.
- Tryland M, Beckmen KB, Burek-Huntington KA, Breines EM, Klein J. Orf virus infection in Alaskan mountain goats, Dall's sheep, muskoxen, caribou and Sitka black-tailed deer. Acta Vet Scand. 2018;60(1):12.
- Tryland M, Klein J, Berger T, Josefsen TD, das Neves CG, Oksanen A, Åsbakk K. Experimental parapoxvirus infection (contagious ecthyma) in semi-domesticated reindeer (*Rangifer tarandus tarandus*). Vet Microbiol. 2013;162(2-4):499-506.
- Turk BG, Senturk B, Dereli T, Yaman B. A rare human-to-human transmission of orf. Int J Dermatol. 2014;53(1):e63-5.
- Vikøren T, Lillehaug A, Akerstedt J, Bretten T, Haugum M, Tryland M. A severe outbreak of contagious ecthyma (orf) in a free-ranging musk ox (*Ovibos moschatus*) population in Norway. Vet Microbiol. 2008;127(1-2):10-20.
- Villadsen LS, Zachariae COC. Unusual presentation of orf in an otherwise healthy individual. Acta Derm Venereol. 2007;88:277-8.
- Vogel TA, Schuttelaar ML. Generalized orf superinfection in a child with atopic dermatitis. Eur J Dermatol. 2013;23(4):538-9.
- White KP, Zedek DC, White WL, Simpson EL, Hester E, Morrison L, Lazarova Z, Liu D, Scagliarini A, Kurtz SE, White CR Jr, Yancey KB, Blauvelt A. Orf-induced immunobullous disease: A distinct autoimmune blistering disorder. J Am Acad Dermatol. 2008;58(1):49-55.

* Link is defunct