

Contagious Ecthyma

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

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IOWA STATE UNIVERSITY
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Importance

Contagious ecthyma is a highly contagious, zoonotic, viral skin disease that affects sheep, goats and some other domesticated and wild animals. The skin lesions are painful and often occur on the mouth and muzzle, where they can cause anorexia or starvation. Lesions on the udder may result in the abandonment of offspring, and foot lesions can cause transient lameness. Secondary bacterial infections can occur and, in rare cases, the lesions may extend into the internal organs. Although contagious ecthyma usually resolves spontaneously and the mortality rate is generally low, deaths can occur from sequelae such as secondary infections or failure to nurse. The economic impact can be significant. Severe generalized infections have also been described occasionally.

Most infections in humans are localized and heal spontaneously; however, large, poorly healing lesions can occur in people who are immunosuppressed.

Etiology

Contagious ecthyma results from infection by the orf virus, a member of the genus *Parapoxvirus* in the subfamily Chordopoxvirinae and family Poxviridae.

Species Affected

Contagious ecthyma mainly occurs in sheep and goats. This disease has also been observed in other ungulates including alpacas, reindeer (*Rangifer tarandus*), Japanese serows (*Capricornis crispus*), musk oxen (*Ovibos moschatus*), bighorn sheep (*Ovis canadensis*), Sichuan takin (*Budorcas taxicolor tibetana*), deer, pronghorn (*Antilocapra americana*) and wapiti/ elk (*Cervus canadensis*), and it is suspected to occur in some wild chamois (*Rupicapra rupicapra*). Limitations in diagnostic testing can sometimes result in a virus being identified initially as orf virus, but later reassigned to another species of parapoxvirus. For example, a disease initially described as contagious ecthyma in camels is now attributed to pseudocowpox virus.

Rare cases of contagious ecthyma have been reported in dogs and cats. Rabbits and mice could be infected experimentally by some groups, but not others; their susceptibility might be influenced by factors such as the viral strain or dose.

Zoonotic potential

Orf has been reported in people who handled infected animals or their tissues.

Geographic Distribution

Contagious ecthyma has been found worldwide in all countries that raise sheep.

Transmission

Orf virus occurs in skin lesions and scabs. It can be transmitted by direct contact or on fomites, and is thought to enter the skin through cuts and abrasions. Whether saliva can transfer the agent in animals with oral lesions, such as reindeer, is still uncertain. Orf virus can be carried by clinically normal sheep; it is reported to remain viable on the wool and hides for approximately one month after the lesions have healed. This virus is very resistant to inactivation in the environment, and 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 or contagious ecthyma vaccines, which contain live virus. The vaccine viruses are also contagious when shed from recently immunized animals. Person-to-person transmission has reported in very rare instances, which included direct contact with lesions or a fomite that contacted both lesions and broken skin. Nosocomial transmission was responsible for one outbreak in a burn ward.

Disinfection

Sodium hypochlorite and two quaternary ammonium-based commercial disinfectants were effective against orf virus in a recent study, 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 for 30 minutes.

Infections in Animals

Incubation Period

The incubation period is thought to be short. Clinical cases have been reported in sheep and goats 2 to 3 days after exposure. Experimental infections in reindeer became apparent in approximately 5 days.

Clinical Signs

Small ruminants and other ungulates

The signs of contagious ecthyma vary considerably in severity, from hyperemia and small pustules around the mouth and muzzle, to extensive proliferative and exudative lesions and scabs that may involve the mucosa as well as the skin. Initially, orf appears as papules, pustules and vesicles, typically found on and around the muzzle, mouth and nose, and sometimes on the ears, eyelids, feet, perineal region or other sites (e.g., the tail after docking). Lesions may also occur inside the mouth, particularly in young lambs and reindeer. Some reindeer were reported to have oral lesions with no apparent cutaneous involvement. These lesions can sometimes become very large. Rarely, lesions may extend into the esophagus, stomach, intestines or respiratory tract. Nursing lambs can transmit the virus to their dam, resulting in lesions on the teats and udder. The skin lesions eventually develop into thick, brown, rapidly growing scabs over areas of granulation, inflammation and ulceration. The scabs are often friable and bleed easily. Papillomatous growths may also be seen.

Contagious ecthyma lesions are painful and can result in anorexia or even starvation. Young animals may refuse to nurse, and lesions on the udder of the dam can cause it to abandon its offspring. Foot lesions can result in lameness. Complications can include secondary bacterial infections (including *Dermatophilus congolensis* on the feet) and maggot or screwworm infestations. Contagious ecthyma can also predispose animals to bacterial mastitis, including gangrenous mastitis. Uncomplicated cases of contagious ecthyma usually resolve within 1 to 2 months.

Severe cases, with more generalized and/or persistent lesions, have been reported in some individual animals or herds/flocks. In one unusual case, Boer and Boer cross goats developed multifocal, severe proliferative dermatitis accompanied by chronic pneumonia, arthritis and moderate to severe lymphadenopathy. The disease persisted for three months until the animals were euthanized.

Other species

In 2008, three cases of contagious ecthyma were reported in cats that had been exposed to farms with infected small ruminants. In all three cases, the lesions occurred on the feet. One lesion was red and friable, with a cauliflower-like appearance. The second cat had a swollen, proliferative, ulcerated lesion between the digits, and the third developed a proliferative, ulcerated lesion on a digit. The lesions recurred

locally in all three cats after excision and/or amputation of the affected digit, and resulted in eventual euthanasia. There is an additional 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.

In the 1970s, contagious ecthyma was suspected in a pack of dogs that had been periodically fed entire, unskinned carcasses from sheep and other animals. The dogs developed circular areas of acute, moist dermatitis with ulcers and scabs, mainly around the head. The outcome was not described. These lesions occurred concurrently with a case of orf in the kennel huntsman, and were diagnosed by inoculation into sheep, with electron microscopy to confirm a parapoxvirus in lesions from the sheep.

Mild to moderate skin lesions were reported in experimentally infected rabbits, and consisted 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](#)

Lesions seen at necropsy generally resemble those in the live animal. Histopathological findings include ballooning degeneration of keratinocytes and eosinophilic cytoplasmic inclusions. Rarely, lesions have also been reported in the esophagus, rumen, omasum, lungs, heart and lower intestinal tract.

In addition to skin lesions, Boer goats with severe infections had severe to moderate lymphadenopathy of the draining lymph nodes in areas of affected skin. Suppurative arthritis, chronic fibrinous pneumonia and premature thymic involution were reported in these animals.

Diagnostic Tests

Infections in animals are usually diagnosed symptomatically. The diagnosis can be confirmed by electron microscopy of the scabs, which should be collected from animals in an early stage of the disease; however, this technique cannot distinguish the orf virus from other parapoxviruses. Histopathology is also helpful. PCR tests may be available from some laboratories. A loop-mediated isothermal amplification assay has also been published.

Virus isolation is uncommonly used, but can be attempted in a variety of cell cultures or embryonated eggs. However, orf virus grows slowly and cannot always be isolated. Serological tests that have been described include serum neutralization, ELISAs, agar gel immunodiffusion (AGID), complement fixation and agglutination. Antibody reactions are generally short-lived.

Treatment

Treatment for contagious ecthyma consists of supportive care, which may include tube feeding, together with antibiotics as needed for secondary infections.

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Repellents and larvicides can be used to prevent the larvae of screwworms or other flies from invading the wounds.

Diathermy and cryosurgery have been used to treat intraoral lesions in lambs but may not be economical. Other novel treatments that have been investigated in the laboratory include topical cidofovir or cidofovir/sucralfate. Surgical excision of nonhealing lesions was unsuccessful in 3 cases in cats.

Control

Disease reporting

Although contagious ecthyma is a common disease, it may be reportable in some areas or countries. Appropriate sources (e.g., state authorities in the U.S.) should be consulted for current information on notifiable diseases.

Prevention

To prevent contagious ecthyma from entering an uninfected herd, new animals should be quarantined; some carriers may not have clinical signs. At shows and fairs, some exhibitors prefer to open their own animal's mouth, to prevent inadvertent spread between animals on the hands. Precautions should also be taken to prevent virus introduction on equipment and other fomites. The removal of harsh vegetation from pastures or feed may reduce the risk of cuts in the mouth or on the muzzle.

Orf virus is difficult to eradicate once it has entered a flock or herd. Isolation of infected animals may help prevent virus spread during outbreaks, and fomites (e.g., troughs and feeders) should be cleaned and disinfected before reuse. Vaccination is practiced in some areas, and can reduce the severity and duration of the clinical signs. 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 isolated from unvaccinated animals until the vaccination scabs have fallen off. Outbreaks have occurred in vaccinated animals, but the cause is not always clear.

Morbidity and Mortality

Outbreaks of contagious ecthyma may occur annually on infected premises, although older animals usually have some degree of immunity. Stressors can increase the risk of clinical signs. In unvaccinated flocks, the morbidity rate is usually high, especially among young animals < 1 year of age (e.g., 80%). While the case fatality rate is usually low in uncomplicated cases (typically < 1%), it can be significantly increased by secondary infections/ infestations (e.g., bacteria, maggots, screwworms), or complications from anorexia. Case fatality rates approaching 100% have occasionally been reported when young animals died of starvation. Unusually severe or generalized lesions have also been reported in some outbreaks, possibly due to more virulent viral strains or animal factors such as breed susceptibility (Boer goats and Fresian sheep might be more susceptible), concurrent health or management conditions,

malnutrition or individual genetic susceptibility. The duration of protective immunity is unclear; however, the illness is usually milder and shorter if reinfection occurs.

The severity of contagious ecthyma in unusual hosts such as cats or dogs is currently uncertain. While all 3 cases reported in cats, to date, could not be cured by excision and resulted in euthanasia, these individual animals might have been unusually susceptible (or milder cases are unreported). One attempt to inoculate cats experimentally in 1923 was unsuccessful. The outcome of the only reported outbreak in dogs was not described.

Infections in Humans

Incubation Period

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

Clinical Signs

In humans, contagious ecthyma usually occurs as one to a few lesions on the skin. The initial lesion is a small, firm, red to blue papule at the site of virus penetration, often a finger or hand. The papule develops into a hemorrhagic pustule or bulla, which may contain a central crust and bleeds easily. In later stages, the lesion develops into a nodule, which may weep fluid and is sometimes covered by a thin crust. It eventually becomes covered by a thick crust. The skin lesion(s) may be accompanied by a low grade fever that usually lasts only a few days, or by mild lymphadenopathy. In uncomplicated disease, the lesion heals spontaneously within 3 to 6 weeks. Secondary infections can occur. Atypical cases, reported rarely, have included eye involvement, or a generalized vesiculopapular rash on the skin and mucosa. Possible complications include toxic erythema, erythema multiforme and a bullous pemphigoid-like condition (orf-induced immunobullous disease).

Large lesions refractory to treatment can be seen in people who are immunosuppressed. Unusually large or widely disseminated lesions have also been reported in people with atopic dermatitis. One nosocomial outbreak among burn patients was characterized by granulation tissue, or 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. Some patients also developed fever and lymphadenomegaly, and secondary infections were sometimes a complication. Two of the 13 affected patients died in this outbreak, but the contribution of the orf virus to these deaths was unclear.

Diagnostic Tests

Diagnostic tests for contagious ecthyma are similar to those used in animals, and may include electron microscopy of the crust, fluid, or biopsy sample; PCR; histopathology; and virus isolation. Animal inoculation into lambs has been reported. Serology and the detection of viral antigens can be used in research, but are not ordinarily used for diagnosis.

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Treatment

In immunocompetent humans, contagious ecthyma is usually self-limiting. Treatment is supportive and typically consists of local antiseptics and dressings as needed, sometimes with finger immobilization and/or antibiotics to treat secondary bacterial infections. The lesions also resolved with only supportive care in some burn patients. Topical cidofovir or imiquimod have been used in some patients with nonhealing or spreading lesions, and may be particularly useful if the person is immunocompromised. Large lesions can be removed by surgery. Other treatments that have been used for refractory cases include cryotherapy, or curettage and electrodesiccation.

Prevention

Abraded or cut skin should not be allowed to contact infected animals, scabs and crusts, wool or hides (including during butchering). Non-porous gloves should also be considered when handling asymptomatic sheep, goats or other susceptible ruminants, especially around the animal's mouth. Gloves should, likewise, be used when administering orf vaccines. Any skin that has been exposed 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 most common among people who are in close contact with sheep and goats, particularly those who handle live animals or hides and wool. Cases have also been associated with cultural or religious practices that involve slaughtering small ruminants. The incidence is often unknown, as many people who work with these animals recognize the lesions and do not seek medical attention. Some studies have suggested prevalence rates ranging from < 5% to 30%. In healthy people, contagious ecthyma lesions typically resolve without specific treatment for the virus; however, lesions refractory to treatment can occur in immunosuppressed individuals. Reinfection has been seen, and usually results in smaller lesions. No deaths have been reported.

Internet Resources

Centers for Disease Control and Prevention
<http://www.cdc.gov/poxvirus/orf-virus/>

eMedicine.com - Orf
<http://emedicine.medscape.com/article/1133450-overview>

The Merck Manual (Professional)
<http://www.merckmanuals.com/professional/index.html>

The Merck Veterinary Manual
<http://www.merckvetmanual.com/mvm/index.html>

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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.
- 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.
- 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.
- 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.

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- 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.
- Gallina LI, Scagliarini A. Virucidal efficacy of common disinfectants against orf virus. *Vet Rec*. 2010;166(23):725-6.
- 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.
- 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.
- 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.
- International Committee on Taxonomy of Viruses [ICTV]. Universal virus database, 2014 release. Orf virus [online]. ICTV; 2014. Available at: <http://www.ictvonline.org/virusTaxonomy.asp>. Accessed 21 Sept 2015.
- 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.
- 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*). *Virology*. 2005;2:79.
- 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. *Virology*. 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, Erkilic A, Kusku M, Analay H, Erkilic S, Benzonana N, Yildirim MS, Mülâyim 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.
- 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.
- 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.
- Scott PR. Overview of contagious ecthyma. In: Kahn CM, Line S, Aiello SE, editors. *The Merck veterinary manual*. 10th ed. Whitehouse Station, NJ: Merck and Co; 2014. Available at: http://www.merckvetmanual.com/mvm/integumentary_system/contagious_ecthyma/overview_of_contagious_ecthyma.html. Accessed 22 Sept 2015.
- Smith M, Sherman D. *Goat medicine*. Pennsylvania: Lea and Febiger; 1994. Contagious ecthyma; p. 22-3.
- 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.
- 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.
- 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