Aetiology

"Ringworm" is the popular term for superficial fungal infection of the skin. In the UK it is the only fungal skin disease that is seen commonly. The fungi that cause skin infections in horses are called dermatophytes and hence the correct term for ringworm is dermatophytosis. The term ringworm presumably derives from the characteristic rings that develop with infection, however the term is misleading as worms or parasites are not responsible for the condition. There are 2 genera of dermatophytes that may infect horses; Microsporum and Trichophyton. In each genera there are multiple species that may affect horses however the vast majority of cases are caused by only a few species. Trichophyton equinum is the most common cause of dermatophytosis followed by Trichophyton mentagrophytes, Trichophyton verrucosum, Microsporum equinum and Microsporum gypseum.

Dermatophytes invade hair follicles where they feed on keratin and produce vast numbers of potentially infective spores. Infection usually requires some existing disruption of the skin surface to enable penetration into the hair follicle. Once infection is established it will remain and spread until the infected hairs cease actively growing or until an immune response develops and the fungi are eliminated. The infection is always self-limiting in healthy animals and eventually resolves. Following infection clinical signs may be seen within 1 to 6 weeks and the lesions often continue to enlarge for a few months before they eventually resolve.

Clinical Signs

Because hair follicles are infected the most common clinical sign is hair loss (correctly termed alopecia) and the skin in affected areas often becomes dry and scaly. Prior to hair loss and scaling the first sign of infection may be erection of the hairs and slight elevation of the skin beneath them.
Occasionally the centre of the lesions will heal leaving a ring of infected skin around it. The lesions are usually non-painful (some minor discomfort may be seen at the start of disease), are not itchy and are typically limited to the head and trunk; infection on the legs being uncommon. Lesions rarely occur in isolation.

Diagnosis
The history of infection on the premises or contact with infected horses and the presence of characteristic lesions is often enough to make the diagnosis. However, the lesions seen can be very similar to those of other skin infections, particularly bacterial folliculitis, rainscald, sarcoids or pemphigus foliaceous. If more than one horse is affected by the characteristic lesions then ringworm is the most likely diagnosis.

The lesions caused by the different dermatophytes are indistinguishable and as treatment is the same regardless of the casual species identification of the species of dermatophyte responsible may be largely academic. On occasions however it can be helpful in identifying the likely source of an outbreak.

Confirmation of infection may be obtained by visualisation of fungi or spores within hair shafts or by culture of the fungi from infected hair or scale. Culture in the laboratory can be difficult however and false negative results do occur. Rarely, biopsies may be required to confirm the diagnosis.

Treatment
Most infections are self-limiting and will resolve without treatment in time. However, there are a number of treatment options that are effective and prompt treatment helps eliminate infection faster and reduce the spread of disease. Treatment may be applied to the individual lesions or used to shampoo or rinse the entire animal. Spot treatment of the individual lesions does nothing to treat other infected areas that are not yet visibly affected and is not recommended therefore. Shampoos have the theoretical disadvantages of little or no residual action and their use may risk damaging further hair follicles and facilitate dispersal of fungal spores resulting in further spread of the lesions. Despite these potential (and perhaps only theoretical) disadvantages a chlorhexidine and miconazole shampoo (Malaseb) has proven to be very effective when used twice a week with resolution generally occurring within 6 weeks. Malaseb is not licensed for use in horses. The most popular treatment in the UK is the application of an enilconazole rinse (Imaverol) every 4 days for 3 treatments. The solution is diluted 1 part in 50 parts water and then applied gently with a sponge over the entire animal. Griseofulvin has been used orally to treat ringworm but results are mixed and the treatments described above are more likely to be effective. Furthermore, griseofulvin is teratogenic and should not be used in pregnant mares, working stallions or animals intended for human consumption.

It is important to consider that whichever product is used, it will take time for the hair to re-grow in affected areas even when treatment has been successful.

Welfare implications
Ringworm is associated with minor pain or discomfort and is not a major welfare concern per se. However, it may be a sign of other underlying disease when it occurs on an individual basis and of
poor management when repeated outbreaks occur on the same property.

**Disease Control and Prevention**

The disease is more common in hot and humid conditions and in situations where large numbers of horses are kept in close proximity. Young horses (less than 2 years old) that have not developed immunity to the infection are highly susceptible and outbreaks on breeding or training establishments that have large numbers of young horses are common.

In the majority of cases, disease is caused by direct or indirect spread from other horses, however certain species are more commonly found on other mammals (typically cats or rodents) and may occasionally infect horses. Some dermatophytes can be picked up from the soil. Identification of the species or dermatophyte responsible for the outbreak can sometimes indicate the likely source of infection. The disease is spread by contact, either direct contact with an infected animal or indirect contact with housing or equipment that has been in contact with an infected animal. Infective fungal spores can survive in the environment for years and can be very difficult to eradicate from affected premises.

In the event of an outbreak affected horses and all of their rugs, equipment, tack, feed bowls etc. should be isolated where possible. The environment around affected animals and their equipment should be cleaned with a fungicidal disinfectant that has activity against fungal spores e.g. bleach, quaternary ammonium chloride or potassium monoperoxysulphate (Vircon).

Following infection, horses usually develop an effective and long-lasting immunity to further infection. Recurrent disease is typically associated with immunosuppressive disorders or housing in unsanitary overcrowded conditions.

Ringworm is a condition that also affects people, however spread from horses to humans is infrequent as most equine cases are caused by a species that is restricted to horses; *Tricophyton equinum*. People do become infected however when other species of fungi are involved and it is therefore wise to take precautions to prevent contacted with human skin especially if the people concerned may be immunosuppressed from other illness or pregnancy.

**Summary of Key Learning Points**

- Ringworm is caused by fungal infection of hair follicles with *Tricophyton* or *Microsporum* species
- The disease is normally self-limiting and causes little suffering in healthy animals
- The lesions are unsightly and highly infectious
- Treatment of both horses and their environment is recommended to minimise disease spread
- Diagnosis is usually made on clinical signs, examination of hair plucks or culture of hair and skin
- Treatment with topical anti-fungal drugs is highly effective but a course of treatment is required
- The environment and any equipment that has been in contact with the affected horse should be thoroughly disinfected with a fungicidal disinfectant that has activity against fungal spores.
- Recurrent infection may be a sign of other underlying disease

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