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THE EQUINE SARCOID
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Introduction:
The equine sarcoid is probably the commonest cutaneous tumour in horses. All 6 forms of the disease have a high propensity for recurrence and become more aggressive if subject to accidental or iatrogenic interference.

The disease affects all breeds of horse, mules, donkeys and zebra. There is some evidence that the thinner-skinned breeds such as the Arabian have a particular tendency towards the condition and others such as the Quarterhorse are less susceptible. Sex (geldings more commonly) and age (1-6 years) predilection have been proposed but recent studies suggest that there is no significant breed, sex or age predisposition. Furthermore, there is known to be a genetic basis for the disease. Several genetic lines have known predisposition but individuals within those lines may not get sarcoilds at all while others may be severely affected. While this may superficially suggest that there is some heritable aspect of the disease it is very important to realize that there are other factors that need to be present for a particular animal to get the disease. It is easy to propose that horses with sarcoilds should not be used for breeding but the genetic tendency to the disease probably exists in a far higher number of horses than actually show overt sarcoid skin disease. The suggested autosomal recessive gene responsible for imparting a susceptibility to the condition influences the severity and recurrence of the disorder in an individual.

Realistically therefore we are not in any position at this time to advise that affected horses should not be used for breeding but I think it is reasonable to try to exert breeding pressure against the disease by avoiding the breeding of two affected horses.

Notwithstanding the genetic susceptibility, I believe that no horse can be considered to be totally exempt from the condition except the few that self cure completely spontaneously.

Sarcoids commonly multiply on the individual horse; sometimes very rapidly while some others remain relatively, or even completely, static for years. Interestingly, a few individuals show spontaneous full and permanent self-cure and in my experience, spontaneous full remission (self-cure) usually means that the horse will not develop further lesions. In a few cases treatment of one lesion (or a few) has resulted in clinical improvement in others at other sites. However, the course of the condition is entirely unpredictable and it is probably unwise to assume that there are any invariable rules about the disorder: even the most benign-looking small lesion can erupt into a potentially catastrophic mass in a short time.

What causes the disease?
For many years researchers have been trying to find a cause for the disease but we are still some way from a definitive answer. The role of papilloma viruses is uncertain - no patent virus particle has yet been conclusively demonstrated but a very high proportion of sarcoilds have genetic material that is identical or very similar to that found in some papilloma viruses. The distribution of lesions and the epidemiology of sarcoilds strongly suggest that flies are significant but how the fly and the virus are linked is another matter yet to be established.

What does the condition look like?
Clinically and pathologically, sarcoilds present most of the features of a true neoplasm; indeed I believe that it is best regarded as a form of skin cancer. However this may not strictly be true in the current pathological interpretation where it is regarded as an induced hyperplasia. However, the term cancer does at least suggest that the behavior of the tumour is unpredictable and that treatment may be problematical. It is however clear that it is not a wart!
Six distinct clinical entities, which are noticeably different, can be recognized. Although each of these forms is commonly identifiable it is important to recognize that the “less severe” forms can rapidly progress to the more aggressive types particularly if they are traumatized. Furthermore the specific types may not be clearly identifiable in every case. It is however, patently obvious that even the mildest forms are indeed sarcoid - *in vitro* cell cultures derived from these are typical and indistinguishable from those taken from the more aggressive lesions. These factors suggest that both cell and host factors are responsible in combination for the variety of forms.

1. **Occult sarcoid:**

The predilection sites include the skin around the mouth and eyes, the neck and other relatively hairless areas of the body including the inside of the forearm, armpit and thigh. Lesions show as hairless areas, often roughly circular. They usually contain one or more small cutaneous nodules (2-5 mm diameter) or roughened areas with a mild hyperkeratotic appearance but these may or may not be present or obvious in every case. An area of changed/altered, slightly thickened skin with thin hair coat and slight changes in hair pigment may be encountered and may be difficult to identify in winter-coated animals. The lesions are characteristically slow growing; they may progress to “warty” verrucous growths or if injured may develop rapidly into fibroblastic lesions. While the lesion remains as a static/quiescent hairless patch showing no evidence of growth in size or number of nodules, it may be wise not to interfere. Cases have existed for over 15 years without treatment or acceleration; however extensive development of verrucose sarcoid or conversion into fibroblastic type sarcoid, usually demand immediate attention. This can occur at any time with or without apparent insult.
2. Verrucous (warty) sarcoid:
This type has a warty appearance with variable degrees of flaking and scaling over limited or wider areas of the body. Most often this type is seen on the face, body and groin/sheath areas. Extensive areas can be affected and are often surrounded by an area of slightly thickened /changed skin (possibly reflecting a surrounding area of early occult sarcoid) with altered, thin hair-growth pattern.

Individual lesions may be sessile (flat-based) or pedunculated (with a narrow neck) giving a true wart like appearance - indeed this type is probably the source of the name “wart” on horses. The name is of course misleadingly benign for a potentially dangerous condition. The lesions are most often slow growing and not very aggressive until injured/insulted. However, small nodules may appear at any stage or over any area of the affected skin. These may develop a true fibroblastic character whether or not they are insulted or traumatised. Rubbing, biopsy, partial excision or minor or major trauma to the surface commonly results in a dramatic change to fibroblastic sarcoid over variable areas of the lesion.

The verrucose sarcoid can be mistaken for papillomatosis (true warts), chronic blistering, severe chronic rubbing or irritation such as can be seen in a few cases of sweet itch).

3. Nodular sarcoid:
The lesions are easily recognisable, as firm, well-defined subcutaneous, spherical nodules of 5-20 mm diameter but can be much larger. Most often this type can be found in the groin, sheath or eyelid areas. The number of nodules varies widely - single, few, several or hundreds are common. The nodules usually lie under apparently normal skin and then may be freely movable; these are termed Type A nodules. However, sometimes there are dermal and deep attachments (termed Type B nodules), which prevent independent movement of the overlying skin and /or movement of the tumour mass relative to deeper tissue. The overlying skin may become thin over larger nodules and when these ulcerate they quickly become more aggressive fibroblastic type tumors. A similar aggressive fibroblastic response commonly follows iatrogenic or accidental or iatrogenic damage.

4. Fibroblastic sarcoid:
These tumors have a characteristic fleshy aggressive appearance and this type is commonly referred to as “Angleberries” (a
name that should be used only for a visually similar type of skin tumour in cattle). Type 1 fibroblastic sarcoid has a relatively narrow pedicle while type 2 has a broad base.

Predilection sites include the groin, eyelid, lower limbs and coronet, sites of skin wounds at any location and sites of any other types of sarcoid subjected to trauma or insult. Both pedunculated and extensive sessile tumours with prominent ulceration and serum exudation are commonly encountered. The latter may reflect single or repeated insults to the “lesser” forms but may develop spontaneously.

They are common at sites of wounds (especially if other sarcoids are present elsewhere). Accidental wounds that fail to heal may contain significant sarcoïd components in the wound margins and admixed with granulation tissue. Surgical wounds are also liable to sarcoïd development. Failure of a surgical wound to heal in a horse with sarcoïds elsewhere could be associated with sarcoïd transformation at the site although there are many other possible causes of the same problem. Concurrent excessive granulation tissue growth serves to confuse the diagnosis. Clinicians should consider sarcoïd involvement in any wound that fails to heal and it is advisable to either biopsy such a wound first or to send any tissue that is removed for detailed histopathology by an experienced pathologist – it can be very difficult to identify small proportions of sarcoïd in a large granulating wound but the implications are profound.

In spite of their aggressive appearance they do not metastasize but can spread locally in dermis by local invasion/extension. Repeated insult (accidental or iatrogenic) encourages local subdermal and dermal invasion.

This type of sarcoïd looks very like “proud Flesh” especially when it develops at the site of a wound and more particularly at the site of limb wounds).
5. Mixed (Verrucous, Nodular and Fibroblastic) Sarcoid
This type of sarcoid probably represents a progressive/transient state between the
 verrucous / occult types and fibroblastic / nodular types. Variations in proportion of the several
types of sarcoid is infinite and complex mixtures of any or all of the above types (containing both
 verrucous and fibroblastic elements) are common in long standing lesions or those subjected to
 repeated minor trauma (such as rubbing by tack or harness). They become progressively more
 aggressive as more fibroblastic transformation takes place - a common consequence of biopsy or
 injury.

6. Malignant sarcoid
This is a recently described variation\(^1\) with predilection sites in the jaw, face, elbow and
 medial thigh areas in particular. A particularly dangerous form occurs in the immediate area
 around the eye. A history of repeated trauma to other types of sarcoid e.g. surgical interference is
 commonly described.

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\(^{1}\)Knottenbelt DC, Edwards SER and Daniel EA (1995) The diagnosis and treatment of the equine sarcoid In
Practice (supplement to Veterinary Record) 17: 123-129
Some cases have no such history with spontaneous development of typical multiple, locally invasive sarcoids. Others show extensive infiltration of lymphatics (cords of tumour are commonly palpable) with numerous ulcerative nodules and surface involvement as well as possible extension to local lymph nodes.

The malignant form of sarcoid is particularly dangerous, not least because there is no current treatment for it. Its appearance is not easily mistaken for other skin diseases but again the presence of several different types of sarcoid elsewhere on the body makes the diagnosis relatively simple.

Sarcoids generally have a high capacity for local tissue invasion into the surrounding skin and other tissues. This is particularly dangerous in the eyelid. This local spread makes treatment very difficult and may explain why sarcoids have a bad reputation for recurrences and the development of new tumours following surgical excision or other interference.

One of the most dangerous problems that occur with the sarcoid relates to those that develop at sites of wounds. Even a small wound on the distal limb can become a very troublesome sarcoid with a complete or partial failure of the wound to heal. While the clinical appearance of proud flesh can be remarkably similar, treatments for the two conditions are very different. Indeed treatment that is suitable for proud flesh (cutting back and grafting) serve only to make the sarcoid even more aggressive and even more impossible to treat effectively. Thus, wound management in all horses, and those with sarcoid skin tumours at other sites (and those with no sarcoids that are genetically susceptible to the disease) are particularly important.

So how can we be sure that a particular skin lesion is, in fact, a sarcoid?

An individual lesion on a horse can be difficult to diagnose although with experience most can be recognized. The large majority of affected horses have more than one lesion and many have over 25 – 30. Multiple tumors with characteristic features of the various types of sarcoid on an individual horse make the diagnosis simple - there are no other diseases with the same range of clinical features and types. A few cases are difficult nevertheless and then biopsy is sometimes required. Some veterinarians are understandably reluctant to interfere with a sarcoid and so may not elect to obtain a biopsy. I have much sympathy with this approach because this interference may trigger a massive and uncontrollable expansion of the lesion. Particular difficulty with diagnosis can arise when sarcoid is diffusely mixed with granulation tissue. Biopsy may be very
misleading if only one of the two tissue types is recognized in the specimen. In most cases diagnosis does not require a biopsy and so treatment can be instituted immediately.

**What treatments are there and how effective are they?**

Treatment should follow as soon after diagnosis as possible. Suspicious lesions can justifiably be treated immediately after biopsy using a suitable regimen. There are ten or more reported treatment methods for the disease and this suggests that no one treatment is invariably effective. Indeed it could be taken to indicate that no treatment is currently very effective at all.

The prognosis is always very guarded and owners should be aware of the possible serious complications, which can arise both from the disease itself and from the treatment. The disease is best regarded as a form of skin cancer. Owners must be aware of the limitations, cost and likely/possible outcome of the various treatment options. There is a strong likelihood that prolonged or repeated treatments will be required. We are all looking for a “sure-fire” treatment for cancers but this is a long way off yet for the equine sarcoid. No case of sarcoid can be considered to be free of the disease even following apparently successful treatment.

**What factors should the vet consider before selecting a treatment option?**

a) The value of the animal and the cost of treatment.

Many treatment methods are expensive and repeated treatments are commonly required.

b) The specific site of the problem.

Some areas of the body have very limited spare skin (e.g. eyelids and the legs) while others have large muscle bulk beneath. Treatment options are very different in the two circumstances and this is further complicated by the variable nature of the sarcoids at different sites. Thus a lesion on the eyelid that looks superficial and benign may in fact be extremely dangerous but may also be relatively innocuous. There is no way of identifying which behaviour an individual lesion will take on.

c) Previous treatments and history.

The prognosis for treatment is significantly worse if an unsuccessful attempt has been made previously. Repeated failures make the prognosis very poor. The first attempt at treatment should be directed therefore at the best available option with the highest chance of success.

d) Complication through coexistence of other factors such as granulation tissue, infection, fly-strike or other tumours at the same site etc.

These may alter both the histological and clinical appearance and may be misleading.

e) Facilities and practicality of the available treatment option.

The best option may be economically or practically impossible. For example radiation carries a good prognosis but is very restricted, requiring special conditions. Cryosurgery of multiple lesions may require prolonged general anesthesia. Very extensive lesions are virtually impossible to treat and so an early attempt is justified.

**Treatment Methods:**

Many treatment methods have been used with varying success. The various treatment methods described below may be more or less applicable to specific types of sarcoid. Treatment must remove every single abnormal cell - leaving even one behind will inevitably, sooner or later, result in return of the tumour (often with a more aggressive form). Notwithstanding the difficulties of treatment of equine sarcoid there are some cases that resolve spontaneously. The proportion of cases doing this is very variable from around 1% in UK to about 8-10 % of cases in Scandinavia. This response certainly occurs and implies that there is some immunological mechanism that could be employed if it could be identified.

Currently there is no effective treatment for the malevolent form of the disease.

- **Ligation:** A ligature of nylon thread, a rubber elastrator band may be used around the base of the lesion to cut off its blood supply. This method is not feasible for flat or
extensive lesions and those where the margins of the sarcoid cannot be accurately defined. In fact it is only really applicable to Type A nodules in which the capsule is demonstrably loose (i.e. that the sarcoid can be moved independently of the skin).

- **Surgical excision:** There is a high rate of recurrence in all except the most confined and defined lesions following surgical excision. Superficial (occult and verrucose) lesions can be effectively treated by wide excision provided that the wound can be closed and then protected during healing. Any delay in healing may be due to sarcoid regrowth. Complete or partial failure of the wound to heal within days of surgery is a common indicator of problems but sarcoid regrowth can take up to 5 or more years to recur at the site.

Notwithstanding the limitations of surgery, excision of Type A nodular lesions carries a somewhat better prognosis provided that the procedure is performed correctly; the skin incision must not penetrate the substance or the immediate periphery of the sarcoid. Once this is done the nodule can usually be gently squeezed away from the subcutaneous connective tissue capsule. Nodular lesions in the eyelids however are potentially very dangerous - they commonly have extensive ramifications through adjacent tissues. Surgery often fails in these cases but there are some success stories.

Type B nodules are tempting surgical prospects but clinicians should be very wary of undertaking this. The extensive ramifications within the adjacent skin can lead to major difficulties both with the surgery itself and the subsequent resurgence of the sarcoid.

Fibroblastic, mixed and malevolent sarcoïds are generally not suitable for surgical excision alone. The prognosis following surgery can be improved somewhat by combining it with other modalities such as cryosurgery, topical cytotoxic compounds, intralesional cisplatin injections or radiation.

- **Cryosurgery (Freezing):** Cryosurgery is commonly employed. While some veterinary surgeons have good success rates it has relatively poor overall success rates (except in the smallest and most defined lesions, which carry a reasonable success rate). Again, the whole lesion must be destroyed without any significant damage to underlying or adjacent tissues. Local scarring may have important effects on function, for example of the upper eyelid or over joints. Cryosurgical necrosis of large lesions and extensive numbers make the procedure impossibly difficult. In general if a surgical option is not feasible a cryosurgical option is also precluded. In some cases success can be achieved by using a full 3 –cycle freeze thaw procedure on a debulked lesion but unless thermocouples are used to ensure proper freezing the results are bound to be problematical.

- **Laser surgery (CO2-YAGor diode laser excision):** Laser excision has a relatively high success rate (and even more so in donkeys) but again selection of the most appropriate lesions is very important. The cosmetic results are however not often acceptable. Equipment is expensive and is not commonly available. The major advantages are the relatively bloodless field and the rapid healing of the normal skin margins. Failure is possible as with any surgical (or other) technique that does not remove all sarcoid cells from the site.

- **Cytotoxic / Antimitotic compounds:** These induce extensive tissue necrosis and scarring. They are easy to apply and relatively cheap. Some complex mixtures of these with antimitotic, corticosteroid and cytotoxic drugs have a reasonable reputation. There are many such compounds available of which AW4-LUDES is one example that has gained a fairly good reputation. It is not applicable to many sites and failures occur (as with all other methods!). These materials tend to be very dangerous and so are strictly veterinary products only. They are invariably unlicensed but the absence of any alternative justifies their use in the cascade system.

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1 Knottenbelt DC and Kelly DF (2001) Management of the periocular sarcoid: a report of the clinical and pathological findings of 450 cases. Veterinary Ophthalmology, 3 pp
Five percent 5-Fluorouracil ointment is available for human use and can be used to treat a few localized superficial sarcoids but the rate of application is high and the course is prolonged. Also it does cause significant discomfort (as do most other treatments). The repeated applications required on a horse that resents the applications can be problematic but with persistence the results are sometimes quite good.

A new method uses tazarotene to alter / normalize the behavior of the keratinocytes so that the true location and extent of the sarcoid can be identified. A much more limited area is invariably established and this allows more focal treatment with less secondary effects. Follow up treatment can be instigated with any of the surgical or other methods described here, including AW4-LUDES, 5-fluorouracil or Xxterra (Indian Mud, USA). The use of AW4-LUDES is currently being pioneered at Liverpool University by the author and results are encouraging. However, there are significant failures also.

- **Cisplatin / 5-Fluorouracil intralesional infiltration:** This is a relatively new method that has only recently become available in UK. Cisplatin is reported to be effective when injected intralesionally at 1 mg cisplatin per ml of tumor in the form of a stable emulsion (usually using medical grade sesame oil). Good results are reported for small fibroblastic and nodular lesions in particular but it requires repeated injection into the lesion itself. In some cases it can be used in conjunction with surgical debulking. Cisplatin is very dangerous to humans; the risks to the human operator and the handler of the horse cannot be overstated. The material is intensely carcinogenic and toxic effects have been seen in humans receiving the drug to the extent that it has fallen from use in cancer therapy in most hospitals. The effects of cisplatin on tumour cells can be significantly enhanced by concurrent electrical treatment (electrochemotherapy). Similar methods using 5-Fluorouracil are possibly much more effective and safer. Both these chemicals can be used in stable biodegradable sponges or slow release beads that might make the treatment far safer and easier and more effective.

- **Vaccines:** Vaccines made from pieces of the tumours have been widely used but the overall results are singularly poor; it sometimes makes the condition even worse. If it worked to any acceptable degree it would surely have become universal practice because it is a theoretically attractive option for a virus disease. As a few cases of sarcoid skin disease do resolve spontaneously it does imply that there may be some immunological effects that might be used. The problem is that we do not know what these are and furthermore we do not know how to encourage this response. It is clear however, that vaccines are not the most appropriate way of inducing this response. As a rule this approach must not be used at all.

- **Immunomodulation:** Proteins including various types of protein cell-wall fractions derived from Bacillus Calmette-Guerin (BCG), and Propionobacterium acnes etc. have been used widely for sarcoid treatment for many years. The material is injected repeatedly into individual sarcoids. Interestingly this method works best with nodular lesions (both type A and B nodules) around the eye but away from the immediate peri-ocular region and in other types of sarcoid there is less obvious benefit. Some fibroblastic lesions on the limbs may in fact become much worse when treated in this way. The method is not appropriate for mixed, verrucose or occult lesions for technical reasons.

A side issue of this method is the occurrence of very alarming (and possibly even fatal allergic reactions) that may occur within minutes or hours of injection. Fortunately we are aware of how to minimize this risk with use of premedicant steroids, flunixin and antihistamines. The risk is nevertheless always there and full emergency facilities must be available when the method is used.

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1 Knottenbelt DC and Kelly DF (2001) Management of the periocular sarcoid: a report of the clinical and pathological findings of 450 cases. Veterinary Ophthalmology, 3 pp
Radiation: Radiation using gamma radiation in linear interstitial sources of Iridium 192 or radio-gold pellets (Au198) or topical radiation using Strontium 90 (beta radiation) may be used. Teletherapy can be used but again the facilities are not widely available to horses.

Radiation is the by far the most successful treatment. However, it is extremely expensive and very limited in availability. It is usually only used for smaller lesions in areas for which no other method is suitable such as the eyelids and over joints etc. If this treatment is offered owners need to be made aware of the problems that include extreme hazard to the surgeon who has to perform the procedure. Rightly, few veterinary surgeons are willing to sacrifice their own lives for a horse. In reality this treatment method is best regarded as a last resort to be used when there is no alternative.

Homeopathic and Other Medicines:
Homeopathic remedies are often used to treat sarcoids but in my experience are very disappointing. I think it unwise to say that none of these will treat cases and so I keep an open mind. Certain natural medicines including Allo Vera, Rosemary Oil and Teetree Oil have however, been found to help a few cases. It is also important to know that in some cases application of remedies of various natural and homeopathic types have resulted in considerable exacerbation of the tumours.

There are several products that are advertised as treatment methods by charlatans and confidence tricksters exploiting vulnerable and gullible people and of course these materials should not be used. Their deleterious effects are probably more a property of the fact that the tumours have been interfered with rather than any directly harmful effect of the ‘treatments’. Any owner embarking on this should be aware that the best opportunity for treatment is being squandered on a method that has a very low probability of any effect and that failure to resolve it will result in a much more aggressive and much more difficult lesion with a much worse prognosis. The reputation of the “medication” is founded on cases that have resolved in any case.

Recently a new material called Xxterra or Sarc-Off (Indian Mud from North America) containing zinc chloride and an extract of the root of the Sanguinaria canadensis plant has been used with some success but the studies and numbers are still too low to make any prediction on its eventual value. It does work in some cases of superficial sarcoid but there are roughly the same numbers of “cures” achieved with application of Vaseline or Tee Tree Oil.

Summary
The equine sarcoid is a cutaneous tumour only. It does not spread to internal organs and so affected horses may be perfectly normal in every other respect. However it is also clear from my experience that individual animals can be affected in less obvious ways. Some horses with few or large numbers of lesions have improved dramatically in their behaviour and performance when the lesions have been successfully treated. This implies that there may be factors associated with the condition that do indeed affect the function of other organs. As the cells do not spread into the major organs we must assume that there are chemical products that get access to the circulation and that these may sometimes have metabolic consequences.

Whenever a horse is found to have a sarcoid lesion it needs to be put into the proper perspective. If you are ‘vetting’ a horse you need to know that the condition is unpredictable. Before a purchaser parts with their money he/she should be sure of the insurance implications and the likelihood that treatment will be required. A single small lesion may remain identical until the horse dies of old age but it could erupt at any time or it may herald the development of more lesions as time passes. It is clear that the fewer lesions that are present at any one time the fewer it will get. I regard it as very important that horses should be as sarcoid free as they can be over the summer months when flies are a problem. Almost every owner of a horse with sarcoids will
recognise that the flies seem to congregate at the site of sarcoids. Fly worry can sometimes cause bleeding and severe worry to the horse.

Treatment at an early stage when there are few small sarcoids is in my opinion the best approach. The prospects for successful treatment are far better if the lesions are small, early and the horse is under 4-5 years of age. None of the treatment methods are cheap and none of them are certain of success – if we can resolve 50% of lesions we are doing exceptionally well. No matter how identical two lesions may appear to be, the response to treatment can be very different - no two cases respond in an identical fashion to a single treatment method. Sarcoids around the face and on the legs are particularly dangerous in almost every aspect of the disease and owners should not be unduly surprised when any selected treatment fails to help: indeed you should not be surprised if the treatment makes matters worse! Furthermore there is no current method for treating microscopic lesions – we can only treat those we can actually see. We would hope of course that eventually we might be able to find a way of making the immune processes of the patient recognise the presence of abnormal cells and reject them – this way every single cell could be detected and destroyed; there would be no more sarcoids. This is some way off yet – if it were as simple as this then we would have an answer to every cancer and disease in every species of animal! We are in desperate need of more effective treatments if we are to rid the horse of this distressing and expensive disease.

The equine sarcoid should be regarded as a form of skin cancer and should be treated seriously in every case; early clinical assessment will help to ensure that the condition is held in check and not allowed to run rampant through the skin of the horse.

**References and further reading**


Knottenbelt DC: Equine Wound Management: Are there significant differences in healing at different sites on the body?  Vet Derm 1997; 8: 273-29
Martens A, De Moor A, Ducatelle R: PCR detection of bovine papilloma virus DNA in superficial swabs and scrapings from equine sarcoi ds.  Veterinary Journal 2001; 161: 280-286
Nasir L, McFarlane St, Tormentegui BO, Reid SW: Screening for bovine papillomavirus in peripheral blood cells of donkeys with and without sarcoi ds.  Res Vet Sci 1997; 63: 289-290
Pascoe RR, Knottenbelt DC: Manual of Equine Dermatology WB WB Saunders, 1999 pp. 244-250