

Tendon Works

How good is the treatment regime?

**‘Tendon Works’ has been re-named Tendonology (the study of tendons);
This change is intended to reflect the commitment to the research and business development
into the understanding of the management of tendon pathology in racehorses and humans.**

Background: Racehorse tendon treatment; how it started, a personal statement

My motivation to look at tendon pathology in racehorses was borne purely out of scientific curiosity. At the time in 2002 I had no previous experience of horseracing generally or specifically to the management of tendon problem in racehorse. Therefore, I genuinely went into it with no preconceived ideas or opinions. When I look back on the past seven years it is somewhat of a curate’s egg! I have had many highlights; great experiences that comes with sport at the elite level. I have made friends and acquaintances with many personalities in racing and had the privilege to look after and treat some top quality racehorses. However, there have also been some really low moments; cynical scepticism and in some quarters very personal and nasty condemnation over what I was trying to ultimately achieve a better outcome for the tendon injured racehorse.

My first impression on the manner in which tendon problems were managed in racehorses back in 2002 highlighted the huge gulf between human and veterinary medicine with respect to the clinical management of tendon pathology. For example, in the practice of human musculo-skeletal medicine there has been a widespread acceptance that protected mobilisation is a preferred method of management for tendon and ligament injuries in comparison to immobilisation. At the time this seemed an alien concept to the veterinary profession. Evidence for this came my way through the common-place use of total box rest for weeks for horses presenting with tendon pathology. In addition, I came across what can only be described as medieval treatment techniques, such as firing and blistering that still had (and unfortunately still does) many supporters within the industry. The lack of any scientific evidence to support the use of pasting burning caustic substances on the skin overlying the affected tendon or placing red hot burning rods or wires into the adjacent skin/tendon in an attempt to promote healing didn’t and doesn’t deter some practitioners from using it.

The original human research upon which I based the racehorse application applied a micro-current based treatment to subjects with chronic Achilles tendonopathy. The treatment is based upon the broad hypothesis that electro-cellular signalling and communication in tendon cells is in some way disrupted which in part results in the formation of chronic degenerative pathology. The explanation for this is that cellular activity and intercellular communication is regulated chemically and electrically and this biological communication process is essential to the maintenance of most physiological processes and is a vital function to repair damaged tissue. When this cellular signalling process is disrupted the normal cyclical balance of tissue regeneration and degeneration is upset which makes the tendon tissue matrix vulnerable to micro damage and compromises the structural integrity of the structure. Measurable research outcomes indicate that a controlled and cell specific sequence micro-current electricity stimulates, restores and optimises intra/extra cellular molecular balance to normalise the tissue environment. In addition, to the treatment a structured exercise rehabilitation programme specific to the severity and type of pathology diagnosed is applied from day one. This is essential to ensure that the new tissue produced is remodelled into the correct configuration.

The biggest changes

The implementation of a structured exercise programme at an early stage of a tendon injury in a racehorse at the time unheard of and this was possibly the biggest single issue for which I received the most vociferous criticism. I was confident that it was the correct and sensible course of action because firstly, it was a tried and tested method in the overall treatment of human tendon patients that was supported with scientific evidence and secondly horses are constantly weight bearing so the concept of box rest was not actually 'rest'. There was not the luxury of being able to elevate limbs! Therefore, structuring exercise was important. The exercise programmes used were carefully thought out and tailored to the particular severity and type of pathology and were not the 'maverick' regimes sometime implied.

The underlying principles for the exercise regime were and remain:

- Consistency & repetition: little and often
- Treating the body as a whole
- Ensuring that any increase in the level of exercise in terms of frequency, intensity or duration, is taken in a step-wise incremental manner
- Good shoeing, keep the toe short and use a shoe with plenty of lateral and heel support. An expert and experienced remedial farrier was used for this
- Avoiding aggravating external factors such as uneven surfaces for example deep sand-based surfaces, small diameter automatic horse-walkers (less than 15m)

This followed a very similar process adopted in an equivalent human patient. It is interesting to note that seven years later this practice has been widely adopted and is more the norm than the exception.

Implementing a thorough diagnostic process was also very important and it too followed a typical human model. Typically a full diagnostic and biomechanical screening process is undertaken not only to assess the type and degree of pathology but also an evaluation of any underlying cause.

In order to deliver this and the complete treatment process it was immediately apparent to me that this type of regime required a very different approach to what was currently the norm - again. I appreciated that in order to undertake my regime I would require the horses to be readily accessible to me everyday for a long period of time. Taking a horse from its training yard for a three to four month period was a completely new and alien concept for both the horse's owner and the trainer. Initially it took some convincing that this was appropriate! In addition, once a horse has completed their in-patient stay of ten weeks they would require a further 8-12 weeks of structured incremental progressive exercise rehabilitation programme to finish the job. I did achieve this and once it was seen that my techniques had merit the word spread and a steady stream of equine patients followed which enabled me to establish a dedicated tendon treatment centre.

Personally, I felt rather exposed with regard to my knowledge – or lack of it in racehorse care and management. Whilst I employed staff with experience and included veterinary cover I felt I needed to gain practical experience and industry recognised qualifications. I felt there was not a question of my knowledge base with respect to tendons and sports & exercise medicine evidenced through my medical doctorate and MSc qualification(s) my racehorse portfolio was rather bare! However, by July 2008 through attending many courses and study days coupled with gaining a diverse amount of practical knowledge thanks to some very helpful trainers I satisfied the British Horseracing Authorities Licensing committee sufficiently to award me a licence to train racehorses for Flat and National Hunt racing. In addition, I am now studying for an MSc in Equine Science with the University of Edinburgh, Royal School of Veterinary Studies.

Where now?

I was never going to please all the people given all the vested interest in the area within which I was working. However, at the top level of racing I had established a strong client base and gathered some really convincing cases that had really influenced some key players in the industry that I was on to something. Tendon Works commenced treating racehorses with tendon problems in 2002; in the period 2002 – 2005 twenty four horses were treated of which eighteen returned to racing. All the horses were admitted as ‘in-patients’ to the dedicated Tendon Works treatment centre for a minimum of ten weeks. During this period all the horses underwent a full diagnostic and biomechanical screening process, a tendon cell regenerative treatment programme and individually structured exercise regimes. Once a horse has completed their in-patient stay they completed a further 8-12 weeks of a structured incremental progressive exercise rehabilitation programme. The period 2005 – 2008 provided the following statistics:

- 64 horses treated
- 44 horses returned to racing (68%)
- 349 days – average time off the racecourse
- 76 days – length of stay at Tendon Works
- £5676 – average complete treatment and rehabilitation cost
- £4267 – average prize money won per horses since returning to racing

The business activity to date and going forward

The business activity was widely successful from the perspective of the acceptance of the treatment techniques the treatment outcomes and the fact that I had managed to penetrate an industry in which I had no previous experience. This was a tough and demanding process which personally came a quite a cost.

Capital expenditure establishing the treatment centre and all the associated equipment added to the large on-going loan repayment costs proved to be too great for the business initially to be sufficiently profitable. Turnover in each of the three financial years 2005 - 2008 was in excess of £120,000 but as is common in business, in the early years, losses were incurred each year due to the ground up capital development of the site. I imagine that in any other time this would not be a big issue; however, the banking crisis that hit the global economy resulted in the company’s bank being prepared to offer a substantially reduced credit facility to the business and the decision was made to sell the freehold premises in 2009 for £1,125,000. In the short and medium term this action will allow the business to be restructured and situated at a property that had less finance secured on it and as such it could operate more independently from the bank.

Summary of financials

In the years October 2005 – June 2009 the tendon treatments had a turnover of £469,090, averaging a monthly income of £10,424. Eighty-one horses were treated with a distribution of October to end of 2005 – 8 horses, 2006 – 29 horses, 2007 – 22 horses, 2008 – 13 horses and to June 2009 – 9 horses treated. The average treatment fee was £5791 per horse with an average 79 day stay.

N.B The business is currently renting the same space at the old premises which has enabled the business to continue at a 'tick-over' rate. Currently three – four horses are being treated every ten weeks. The 2009 total will be around 18 horses.

The future business strategy

Given a revised structure the business has the potential to be financially profitable however because of the relatively small margins for each horse treated the particular issue of costs and debt had to be addressed. Three items stood out in the previous accounts as being particularly corrosive:

1. Loan repayments

High loan repayments incurred for the purchase and on-going capital expenditure developing the premises from the ground upwards establishing the treatment centre and other facilities.

2. Staff costs

With the best intentions of providing a first class service, staffed with well paid, highly motivated staff the costs significantly reduced the potential profit margin. In hindsight the centre was over staffed, with a ratio of almost one member of staff to one horse. This was not viewed as a gross management error, more a desire to establish the service with the best possible start.

3. Capital expenditure

The original treatment centre was established from scratch on a green field site. The ambitious extent of the development was undertaken at a rate that led to losses being sustained in the initial years of the business. Had the banking calamity not hit the global economy I imagine that the bank would have been considerably more flexible with its credit facility would have enabled the business to gain from its first three years of development. It did seem very short sighted of the bank to effectively reduce the facility overnight. However, in order to build upon the successes of the current business activity these issues will be addressed. In addition, it is planned to undertake a complimentary activity the training of racehorses which will provide a second income stream.

Solutions going forward

1. Premises

Two options were evaluated for the new premises, renting or buying. Some rental premises were considered but due to the specialist nature of the tendon treatment business were deemed unsuitable without further capital investment which would not be recoverable on a rental property. Therefore, it was concluded that buying a site was the only viable option. In order not to repeat previous situation of having of a high level of debt a slightly scaled down version in comparison to the original centre is planned. A new site for the tendon and training treatment centre has been identified which is significantly cheaper than the previous property.

2. Staff costs

Expenditure on staff has is to be proportionate to income. A more measured horse/staff ratio will be adopted without excessive salary rates.

3. Capital expenditure

Any new capital expenditure will be conducted at a rate proportionate to income with further development undertaken commensurate with business activity.

Abstract: Racehorse Statistics

Background

Strain-induced tendon and ligament injuries in racehorses are very common, significant and present themselves in a variety of different ways. The majority of tendon injuries present a great burden in terms of the number of injured horses and financial loss to the racing industry. The superficial digital flexor tendon is the most commonly affected tendon and the suspensory ligament the most frequently affected ligament. Current 'traditional' treatment regimes only have a minimal effect on the outcome after injury and there is a high risk of re-injury. This suggests that treatment regimes are not highly effective. David Chapman-Jones through Tendon Works has been treating racehorses with such injuries since 2002 adopting a completely new treatment and management philosophy and method. The following paper documents the results of an audit of the horses treated in the period 2005 – 2008.

Method

Tendon Works commenced treating racehorses with tendon problems in 2002, adopting a novel treatment and rehabilitation regime that had been proved to provide a statistically significant improvement in human subjects presenting with chronic Achilles tendon pathology. In the period 2002 – 2005 twenty four horses were treated of which eighteen returned to racing. All the horses were admitted as 'in-patients' to the dedicated Tendon Works treatment centre for a minimum of ten weeks. During this period all the horses underwent a full diagnostic and biomechanical screening process, a tendon cell regenerative treatment programme and individually structured exercise regimes. Once a horse has completed their in-patient stay they completed a further 8-12 weeks of a structured incremental progressive exercise rehabilitation programme.

Results

The period 2005 – 2008 provided the following statistics:

- 64 horses treated
- 44 horses returned to racing (68%)
- 349 days – average time off the racecourse
- 76 days – length of stay at Tendon Works
- £5676 – average complete treatment and rehabilitation cost
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Conclusion

The initial results released for the period 2002 – 2005 were greeted by many in the horseracing industry with great scepticism and, in some quarters, criticism. The results from this period confirm the initial findings which have been independently audited. There does appear to be a clear association between the racehorses treated, the resultant functional capacity of the tendon and the horses return to racing. Given the problems that tendon pathology causes to owners and trainers the fact that 68% of the horses treated returned to racing suggests that this treatment is a sensible consideration for a horse presenting with such pathology.

Introduction

Preamble: Justification of methodology adopted.

Accurately assessing the efficacy of a treatment regime requires the application of a reliable and preferably objective measurement of the clinical outcome. Achieving this is particularly problematical when evaluating the functional capacity of a living biological structure and when clinical indicators are not of a constant nature. Meaningfully evaluating the worth of a regime for treating tendon pathology presents such problems. Intrinsic and extrinsic factors over age, sex etc include biomechanical variables, present and past levels of physical activity and previous pathology; all act as significant confounders which can influence a clinical outcome and as such make it difficult to standardise an average subjects. This causes problems when using a prospective comparison research method because it can lead to outcomes being open to mixed interpretation. This lack of scientific clarity is made even more difficult when the subjects under assessment are non-human such as racehorses. With communication between subject and assessor reduced to the most basic level the best the researcher can do is to look for a scientifically based association between the pathology, the treatment and the chosen method to assess clinical outcome.

The purpose of this latest audit for the period 2005 – 2008 was to assess whether the Tendon Works treatment regime, developed by David Chapman-Jones, that had been proved to provide a statistically significant improvement in human subjects with chronic Achilles tendon pathology, had repeated the effect seen in a pilot study of a group of racehorses (n=24) in the period 2002 – 2005. This group of racehorses showed that 75% (n=18) of the horses treated had returned to the racecourse following the application of the Tendon Works treatment and rehabilitation programme.

The original human subject based research applied a micro-current based treatment to subjects with chronic Achilles tendonopathy. The treatment was based upon the broad hypothesis that electro-cellular signalling and communication in tendon cells are in some way disrupted which in part results in the formation of chronic degenerative pathology. Cellular activity and intercellular communication is regulated chemically and electrically and this biological communication process is essential to the maintenance of most physiological processes and is a vital function to repair damaged tissue. Measurable research outcomes indicate that a controlled and cell specific sequence micro-current application stimulates, restores and optimises intra/extra cellular molecular balance.

Background; Tendon pathology in racehorses

Over strain-induced tendon and ligament injuries in horses are very common and present a great burden in terms of injured horses and financial loss to the racing industry. Tendon and ligament injuries are very common in racehorses and account for 30% of wastage of young thoroughbreds. These injuries also sideline an estimated of 25-30% of National Hunt horses in registered training – or not as the case is! An ultrasound study on National Hunt horses in training showed that almost one half of all horses (43%) had evidence of tendon pathology. A conservative estimate based upon anecdotal evidence suggests that tendon injuries normally take 12-18 months to heal and often render the horse to a reduced functional capacity post-injury. (There is very little good quality published data about injury incidence and return to full racing function).

Anecdotally about 10% of these horses presenting with tendon injury and treated with traditional regimes return to the racecourse.

The superficial digital flexor tendon (SDFT) is the most commonly affected tendon and the suspensory ligament the most frequently affected ligament; 46% of all injuries at racecourses. It is almost certain as is the case in the majority of human subjects, that an injury is nearly always preceded by chronic degeneration in the tendon. When there is a repair a type III collagen (scar type tissue) replaces the normal type I collagen. The scar tissue (type III collagen) has different mechanical properties to the inherent type I collagen which increases the risk of re-injury. Therefore, an optimal treatment would be one that prevents this chronic degeneration and promotes a repair with a type I collagen.

Current treatment regimes only have a minimal effect on the outcome after injury and there is a high risk of re-injury suggesting that these treatment regimes are not highly effective. There does not appear to be a consensus among clinicians about the most appropriate treatment to apply in cases of tendon injury with the general current thinking being that horses with these types of injuries should be fired, rested, retired from racing or destroyed.

It is clear that the mismanagement of tendon injuries has significant implications because even a small degree of loss of tendon strength can result in a dramatic rise in the chance of a career threatening injury. Therefore, for equine health and economic reasons a new and effective preventative and treatment regime is required.

Methodology

The method we used to assess the efficacy of the treatment was to take a group of top-level racehorses with a range of clinical presentation/pathologies of the superficial digital flexor tendon. A presenting horse undergo a pre-assessment and if they adhered to our selection criteria they were exposed to the new treatment regime and a specific exercise programme applied over a ten to twenty week period. Each horse was then tracked for a year to ascertain whether they returned to racing or not.

We estimated, using evidence from practising veterinary clinicians that current treatment methods were operating on a 10 - 30% success rate, dependant upon the severity of the condition, with horses being out of competitive action for twelve to eighteen months.

Subject Selection Criteria

All horses treated were thoroughbred racehorses and in the opinion of the referring veterinary clinician and trainer 'broken down' to a point where they could not stand up to either training or racing. The group contained horses that had complete ruptures of the superficial digital flexor tendons at one end of the scale to those that had core type lesions shown on ultrasound but with no external visible changes in the tendon but were unsound at exercise at the other.

To all intents and purposes each horse provided an individual case study. Prior to the arrival of each horse the following information was provided by the referring clinician and/or the trainer.

- Name of Horse, Passport Number, Age
- Flat Racer/National Hunt/No. of years in Racing:
- Any known clinical condition?
- Vaccination Due Date, date last wormed, date of last shoeing
- Does the horse have any Vices? i.e wind sucking, crib biting, weaving etc.
- List any known allergies:

Clinical History

- Brief history of the injury/condition:
- Has the condition been assessed by a vet?
If yes, the date and name and contact details of the attending vet:
- Outline of the attending veterinarian's diagnosis, prognosis and grade of pathology according to the Tendon Works grading system:
- Was an ultrasound examination undertaken, if so date?
- Can the ultrasound images be made available for Tendon Works?
- What treatments, if any have been used for the injury to date?:
- Has the horse had a previous history of a tendon injury?

Current Activity

- Outline briefly the current level of exercise activity the horse is undertaking:
- Briefly state the fitness condition of the horse, i.e racing fit, pre-training, turned away:
- How is the horse on the road/with traffic?
- Special tack requirements?

Feeding/Box Regime

- Outline the current feeding regime, to include frequency, amount per feed (kg) per day, hay or haylage:
- Any supplements/medication currently fed/administered?:
- Any special dietary requirements?:
- Current bedding:
- Any other information you feel may be useful to ensure the optimum welfare for the horse for its stay at Tendon Works?

Grading of Pathology

All the horses were assessed at Tendon Works and their condition graded as follows:

We also request that all referring vets attribute a grade to the horse in their care being referred for treatment.

Grade I

If the condition matches all of the following

- Horse of five years or younger
- Single fore leg pathology in the superficial digital flexor tendon SDFT
- The SDFT lesion accounts for $\leq 30\%$ of the affected cross-sectional area
- No previous history of tendon injury to either fore SDFT
- Not presenting as lame at walk

Estimated treatment time: Ten weeks

Generalised prognosis: Based upon similar cases treated at Tendon Works:

- ✓ Returning to racing: 90%
- ✓ Returning to racing: Within twelve months - 75%
- ✓ Horse remains sound after twelve months/four races – 84%
- ✓ Overall prognosis: Very good

Rationale:

1. Younger horses respond to the treatment more quickly primarily because the regenerative cellular processes are more active in the younger horse.
2. Single leg injuries present less of a problem in terms of rehabilitation and have a better prognosis
3. In cases with smaller lesions there is less distortion of the tendon tissue matrix which improves the overall outcome

Grade II

A horse's condition will be a Grade II if the condition has any of the following in addition to, or to replace those in Grade I

- Horse is older than five years old
- Single fore leg pathology in the SDFT which accounts for 30% - 50% of the affected cross-sectional area of the SDFT or bilateral fore leg SDFT lesions which account for $\leq 30\%$ of the affected cross-sectional area of the SDFT
- No previous history of tendon injury to either fore SDFT
- Not presenting as lame at walk

Estimated treatment time: Twelve weeks – sixteen weeks

Generalised prognosis: Based upon similar cases treated at Tendon Works:

- ✓ Returning to racing: 60 – 70%
- ✓ Returning to racing: Within twelve months - 60%, within eighteen months - 72%
- ✓ Horse remains sound after twelve months/four races – 75%
- ✓ Overall prognosis: Good

Rationale:

1. The degenerative process in the older horse will be more advanced than in a younger example. Most degenerative pathologies in the SDFT are sub sensory and in the early stages can not be detected with diagnostic ultrasound
2. Older horses respond less quickly to the treatment primarily because the regenerative cellular processes are less active in the older horse.
3. Single leg injuries present less of a problem in terms of rehabilitation and if the horse presents with bilateral lesions it more than doubles the problem.
4. In general the larger the lesions the more distortion and disruption of the tendon tissue matrix which will compromise the overall prognosis

Grade III

A horse's condition will be a Grade III if the condition has any of the following in addition to or to replace those in Grade I or Grade II

- Bilateral fore leg pathology in the SDFT's in which pathology in one or both leg (s) accounts for $\geq 50\%$ the affected cross-sectional area of either SDFT
- A previous history of tendon injury to either fore SDFT
- Presenting as more than 5/10 lame at walk
- Gross enlargement of either SDFT defined as being \geq twice the normal dimensions
- Previously fired

Estimated treatment time: Twenty weeks

Generalised prognosis: Based upon similar cases treated at Tendon Works:

- ✓ Returning to racing: 50%
- ✓ Returning to racing: Within twelve months – I would not recommend it, within eighteen months - 55%
- ✓ Horse remains sound after twelve months/four races – 62%
- ✓ Overall prognosis: Fair

Estimated treatment and rehabilitation time: Twenty weeks

Rationale:

1. Older horses respond less quickly to the treatment primarily because the regenerative cells are less active in the older horse.
2. Severe bilateral pathologies with over 50% structural damage present significant treatment and rehabilitation problems. At Tendon Works we do not subscribe to the opinion that the chances of horses with this level of pathology have a less than 50% chance of ever racing again. However, returning the tendon to a fully functioning and durable unit takes an individual and patient approach based upon an accurate diagnosis and regular monitoring.

The Treatment Process

In summary, the treatment protocol is based upon work conducted on human tendons both in the laboratory and in living subjects presenting with tendon pathology. This research has been undertaken by a variety of clinicians and scientists and published in reputable peer reviewed journals. A summary of over one hundred reviewed articles may be found at the following website www.synapsemicrocurrent.com/science.html

To date a little over 120 horses have been treated with the application. The horses that have been treated have not been part of a controlled scientific study; therefore, the results have an element of subjective interpretation. Certainly in human patients/subjects the treatment has been remarkably effective and the application is currently being considered for N.I.C.E (National Institute for [Health and] Clinical Excellence) approval as the treatment of choice for tendon pathology.

The horse cases accepted for treatment have in many circumstances been very severe and as such this treatment has been viewed as a last chance option. Given this the number of horses that have been returned to racing in my opinion and the referring trainers who have acknowledged that they have sent some real 'horrors and no hoppers', is quite remarkable. In the period 2003 – 2005 of the thirty horses treated twenty two returned to racing and remained sound.

The treatment is delivered in an 'in-patient' treatment centre; the horses stay for treatment and rehabilitation for a minimum of ten weeks.

The Treatment

The treatment is based upon the hypothesis that whilst tendon tissue is constantly in a state of biological regeneration and degeneration this process occurs slowly and should be in a state of equilibrium. However, in many cases this is not the situation and the degenerative phase runs ahead (at times significantly) of the regenerative phase. This leaves the structure potentially vulnerable to mechanically induced stress overload and ultimately breakdown. One suggestion for the sluggish regenerative cycle has been identified as a slowing or blocking of the cell to cell molecular communication processes via channels called gap-junctions. This processes are to a degree controlled by electro-chemical signalling.

Put simplistically the treatment re-ignites this signalling process by applying, little and often, a cell specific electric charge to the affected area which appears to re-engage these cell communication channels promoting a cascade of physiological events that follow. The end result of this being that greater amounts of new tendon tissue is produced.

In a recently published in Nature Journal, one of the most distinguished scientific publications (July 26th 2006) that outlines the role of electrical fields/charges in wound healing and how an externally applied electric charge can augment the healing phase of tissue repair. This paper examined the process at a genetic level and by and large supports our general hypothesis applied to tendon tissue]

Throughout the treatment and rehabilitation process regular ultrasound examinations are conducted in order to assess the progress of healing as the new tissue is formed into a new tendon structure. This enables us to accurately gauge the intensity, duration and frequency of the exercise programme.

What actually does the treatment involve?

With regards to the treatment and process two questions are commonly asked:

1. 'What actually is the treatment' or/and
2. 'What exactly are the treatment parameters/sequences of electricity you use?'

1. The answer to the first is easy to provide; for the superficial digital flexor tendon (SDFT) because it is a superficial structure we can apply the treatment through the skin. The treatment is a series of a very cell specific electric current introduced into the area with special applicators which causes the tendon cells (tenocytes) to reproduce at a greatly increased rate and also to produce more tendon tissue.

The frequency, duration of individual treatment sessions and how long a treatment series lasts depends upon the severity of the condition and also more importantly how the individual tendon responds. It is very possible to 'over cook it' and cause a down regulation of cell activity. The science behind how it works is outlined in the earlier noted sources. (www.synapse-medsolutions.com/morescience.htm.)

2. The answer to the second question regarding the treatment parameters is not so easy to answer because that is our intellectual property, but outlined in our granted patents. All cells and cell membranes respond to different intensities of amplitude, frequency and polarity and this is where the time in research and development has been spent obtaining optimum parameters.

Treatment Rationale

I believe I offer a treatment regime that is responsible, rational and proper treatment. It will not be successful in all cases but I am of the opinion that for many conditions it is the best option available. This statement is based upon the fact that I offers a well thought out programme of treatment and rehabilitation set for the individual condition and requirements of the equine patient. The process is labour intensive and not an inexpensive option. The horses are effectively inpatients at the centre for a relatively long period of time.

I have adopted this principle because we believe that it will give the horse the opportunity to arrive at the best long-term outcome.

Are the success rates subjective?

I have conducted treatments on many top racehorses from the Flat and from National Hunt. These have been referred by leading trainers and owners. In several cases we have a steady flow of repeat business. Several of these horses have gone on to race at the highest level. Whether that proves that it was our treatment that was the cause is impossible to comment on accurately because for equine application it has not been exposed to a carefully controlled scientific study. To be honest this has to be set in the context that neither has any other treatment available for equine tendon problems. The plain fact is indisputable in the period 2005 – 2008 of the 64 horses treated 44 horses returned to racing (68%).

I have grave concerns about the 'treatment only' options and believe that data produced that claims to provide a comparison with regard to evaluating the efficacy of one treatment over another is often unreliable and misleading. Evaluating the worth of a treatment by measuring the outcome as returning to racing or re-injury rates when horses undergo the same treatments [let alone different ones] but are exposed to a variety of rehabilitation programmes makes such data practically and scientifically worthless.

The difficulty in creating and monitoring clearly defined and controlled *in-vivo* (life) studies have allowed many treatments to be promoted and used sold off the back of personal reputations rather than robust clinical verification. Unfortunately there is a paucity of good quality, verifiable and reliable data in this area of study. Treatment regimes appear to be frequently based upon personal preference rather than rational clinical decision-making.

Importantly, I would say that a poor rehabilitation programme can ruin a good and potentially effective treatment and a less effective treatment can be greatly enhanced by a good rehabilitation regime implemented by an experienced and knowledgeable professional. Such is the difference and influence that this aspect can bring.

General discussion on horse tendons and treatments

Horses presenting with tendon problems have historically been the nemesis to veterinarian and trainers alike. Many treatment methods have been tried; in some cases tested and mostly fallen by the way side. Possibly the reason for so many false dawns in the search for a reliable treatment for tendon trauma/pathology is that many of them do not take into account the healing and metabolic processes that occur naturally. Instead human intervention causes as many, if not more, problems as solutions. For example, it is understood by clinicians [human and animal alike] that disorganised scar tissue present in a highly organised structure such as the tendon tissue matrix will disrupt that ordered structure to the detriment of the functional capacity of the tendon. However, treatments such as blistering and firing blatantly ignore basic science I could argue to the detriment of the horse's welfare and long-term viability as a racehorse. The justification that such treatments promote an increase in blood circulation to the area to promote healing or that it provides a fibrous splint for the tendon clearly does not stand up to even the flimsiest of scientific scrutiny. The fact that some horses do return to racing following these treatments does not mean that they work. Merely that in some cases it does not prevent a horse from returning to racing.

There are two clear facts that must be considered when dealing with tendon pathology, firstly the longitudinal arrangement of the collagen fibres that make up 90% of the structure of the tendon needs to be maintained and when disrupted through injury and pathology promoted by regular exercise at a frequency, duration and intensity appropriate to the condition of the tendon. Secondly, disorganised fibrous tissue will be detrimental to the long-term viability of the functional capacity of the tendon, therefore opportunity for the accumulation of this should be minimised.

When I set about evaluating the efficacy of the treatment in 2003 regime in a clinical model I was clear that it had the potential to be of some clinical use because basic science had highlighted that it had the effect of promoting enhanced levels of cellular reproduction and also collagen synthesis.

In a randomised, prospective, control trial it had proved to be effective in treating human patients presenting with Achilles tendon chronic pathology. [Incidentally, in human patients the Achilles tendon pathology causes as many clinical treatment problems as the superficial digital flexor tendon in competition horses]. This human study examined 96 (ninety-six) subjects, half of which were treated with the new treatment regime and half undergoing conservative physiotherapy based treatment regimes. Patients were followed for a one-year period and assessed using a variety of methods such as diagnostic ultrasound, flexibility testing, pain scores and functional capacity tests at three monthly intervals.

Eighty percent (80%) of subjects showed a significant improvement in each of the assessment markers whereas thirty five percent (35%) of the conservative treatment group showed a comparable improvement.

These results maybe because tendon tissue is biologically unusual in that it follows a pattern of embryonic regeneration. This means that the tissue is constantly being broken down and replaced with new tissue. In other words there is a constant cycle of degeneration and regeneration. If this cycle maintains equilibrium, despite the fact that there may transient changes in the balance, it will remain within a functional tolerance.

However, particularly in the superficial digital flexor tendon in the horse this balance is not maintained [cellular activity is significantly reduced after the horses reaches the age of three/four]. The reasons for this are not yet clearly understood. However, the effect of this reduced level of cellular activity is the reduced capacity of the tendon to adapt and respond to repeated levels to mechanical stress induced micro-trauma. This is why we see degenerative pathology prevalent in the older horse. The same is also true in humans.

I am clear that if the level of cellular activity is enhanced the capacity of the tendon to adapt to mechanical overload or rebuild itself when the tissue matrix was disturbed would be possible. This was exactly what was happening to cells in tendon sections isolated and exposed to the treatment in laboratory conditions. The rate of cellular reproduction was increased up to seven hundred (700) times and collagen production up to five hundred per cent (500%). The research is focussed upon the manipulation of cellular behaviour utilising the normal physiological process of electro cellular signalling and communication. This research has been particularly directed upon the atypical biological regenerative cycle of tendon tissue.

My team's research focused upon the ability to use a cell specific electric current to manipulate/influence two key basic cellular functions proliferation and differentiation in treating tendon pathology and injury. The findings had highlighted that the application of specific micro/pico-current had the effect of;

1. Increasing tenocyte proliferation rates;
2. Increasing the cellular production of type I collagen;
3. Increasing the levels of mitochondria ATP.

At the time of undertaking these experiments I was unsure of what was the precise biological mechanism that underpinned these findings, although others had already hypothesised that calcium transport/signalling might be implicated in the process. It is already known from experimental work with tendon sections harvested from dogs, that tendon cells respond to stress put on them by mechanical load by releasing stored calcium.

This calcium release results in a cascade of molecular events which ultimately sends a signal to the nucleus of the cell causing specific gene products to be produced and influence such functions as replication and protein (collagen) production.

It is interesting to note that in the immature racehorse there is a considerable level of collagen synthesis in the SDFT, which tails off as the horse matures; this contrasts with the common digital extensor tendon (CDET) that maintains collagen turnover into maturity. Injury to the SDFT is a very common occurrence, which prematurely ends the careers of many competition horses whilst injury in the CDET is rare. Whether this stasis of cellular activity in one tendon and not in the other is a contributing factor to the high difference in injury rates was considered. It can be summarised (a bit of science) as the following:

Tendons and ligaments have a highly structured and ordered cellular organisation within the tissue matrix. Tendon cells are arranged in longitudinal rows between collagen based fibre bundles. Within the rows the cells are arranged in a manner so they are in contact end-to-end. Between the rows they are in contact via processes that extend around the collagen fibrils so one cell will meet up with a process from another cell. Where tendon cell membranes meet they contain gap junctions.

These gap junctions are specialized areas of the cell membrane that are organized collections of protein channels that allow ions and small molecules to negotiate their way between connected cells. These channels facilitate cellular communication, which enable cells to balance their key regulatory ions and molecules. It appears that the major physiological role of the gap junction is to synchronize metabolic and electronic signals between cells enabling key functions such as proliferation and differentiation. It is believed that different types of gap junctions occur in lateral and longitudinal planes which have different communication characteristics therefore in theory will have differing capacities to pass messages longitudinally and laterally. This makes sense as the principal line of strain is along the longitudinal plane. It is suspected that the failure in the correct function of these gap junctions is responsible for the significant down regulation of cellular activity in tendon cells. I hypothesised that the construction and function of the gap junction maybe be influenced by externally applying electrical stimuli.

Research demonstrated that externally applying electrical stimuli returned the treatment group's cellular communication to what can only be described as an enhanced normal state with increased levels of cellular reproduction and protein synthesis in comparison to baseline levels.

Therefore, could it be extrapolated from this that poorly functioning cellular communication systems caused as a result of illness, injury or a generalised cellular go-slow can be corrected so serving to return them to a normal or enhanced state of function? It suggests that it may provide the ability to be able to externally regulate and control cellular communication by improving the synchronization of metabolic and electronic signals between cells in tissue, thereby opening up a new world of possible treatment applications.

Conclusion

Associating these latest set of results of an application that has its base in science and medicine with the word proof is an ill-advised term to adopt, particularly when dealing with work involving living subjects (in-vivo). There are so many intervening variables which act in some cases to confound, others to aid and some hinder. Therefore, claiming that a treatment cause a direct effect, without the support of irrefutable evidence is very problematical and in my view unwise. I believe the most that can be achieved when assessing a treatment regime is that there is an association between exposure to the treatment and the outcome either objectively or subjectively measured. Even then it is rare that pathology presents in a strictly homogenous fashion in a group of similar subjects.

The horses presented with a variety of pathologies and/or injury induced pathology in tendon tissue, primarily the superficial digital flexor tendon. There does appear to be a clear association between the horses treated, the functional capacity of the tendon and the horses returning to racing. Given the notorious problems that tendon pathology causes to owners and trainers the fact that 68% of the horses treated returned to racing with an average time post-treatment and back to racing of within 50 weeks suggests that this treatment has the potential to be used more extensively.

Generally the subjects treated were good quality racehorses racing at a competitive level. The results of the racehorses mirror those obtained in human subjects competing in elite sport. This makes sense because tendons are very similar in all mammalian species. This is a treatment used extensively in human patients for the last ten years.

I've no doubt, that for whatever reason the detractors will remain. However, I am content that the results support that fact I believe this treatment regime provides a credible option for racehorse owners and trainers. All the statistics are verifiable by independent third parties and cannot be disputed. The treatment does not aim to speed the process of healing up significantly more the aim is provide an improved outcome.

The £5676, average complete treatment and rehabilitation cost is not inconsistent with the £4267 average prize money won per horses since retuning to racing. The treatment is designed to improve their tendons not make them better horses!

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