Electrotherapy News

VOLUME 4 | ISSUE 2 | October 2008

Electrotherapy News is sponsored by

Hi and welcome to the latest edition of Electrotherapy News. Sorry for the long delay since the last edition, but time has been tight, and the real job seems to get in the way of doing the things that I would like to do the most. Anyway, hope you enjoy another eclectic mix of research papers I have found here and there. As ever, if you have any items for inclusion, papers you have written and I appear to have missed or anything else relevant to electrotherapy, please do let me know on **t.watson@herts.ac.uk**

NEWS – International Electrotherapy Conference

FIRST CONGRESS OF THE INTERNATIONAL SOCIETY OF ELECTROPHYSICAL AGENTS, 8th to 9th FEBRUARY 2009, LAS VEGAS, USA

I have mentioned previously that an International Electrophysical Agents society was getting going, and I am pleased to let you know that the 1st Congress of that group is scheduled for February 2009 in the USA. The programme is looking exciting and rather than try and reproduce pages of it here, the best thing to do is head for the web sites as detailed below. I will host some summary pages on the www.electrotherapy.org web pages once I have copied the info across etc.

Online registration for the ISEPA congress is now available via the APTA website (www.apta.org/CSM). Please note that the ISEPA congress is listed as a CSM Preconference Course, under the Clinical Electrophysiology and Wound Management Section.
Additional information about the Congress, future updates as well as discussions pertaining to the proposed formation of ISEPA can also be found at one of the forum pages www.wcpt.org/smfforum/index.php/board,68.html which is within the WCPT website.

I will be there (so long as I can find some cash for the flights etc) and look forward to meeting up with a whole host of people with an International reputation and interest in EPA's. Great to see as many people as can make it.

NEWS – Web Site Updates

There have been several updates to the web site (not big structural ones like last year) with the common modalities pages (Ultrasound, Interferential, TENS and Pulsed Shortwave) all being updated, together with the handouts (on the DOWNLOAD page) that go with them. The Current Concepts has also had a bit of a makeover, and I continue to expand the less common modality pages, including some new material on Shockwave Therapies.

NEWS – Recent Papers

There are a couple of papers of mine which have come out in the last couple of months. One on Ultrasound which I have mentioned previously – which is a review of the current evidence base for this modality and can be found at : **Watson, T. (2008). "Ultrasound in contemporary physiotherapy practice." Ultrasonics 48; 321-329**.

The other which might be of interest has just come out and is based on a piece of work by Leon Poltawski as a part of his current PhD and looks at problematic soft tissue disorders. It does not, I hasten to add, provide any answers about what to do with them (before you get too excited) but does look at which clinical problems are deemed to be most problematic and recalcitrant. It can be found at : **Poltawski, L. Watson, T. and Byrne, G. (2008) Physiotherapists' perceptions of problematic musculoskeletal soft tissue disorders. Int J Therapy Rehabil 15(10); 437-444.**

NEWS – Ultrasound for Apomorphine Nodules

The study that we completed recently which looked at the potential benefit of therapeutic ultrasound when used for subcutaneous nodules in patients with Parkinsons has generated several papers. Some are still in press, but a couple are already out there. Details of these together with the updated guidelines can all be found on the web site – link from the home page.

NEWS – Old Books

Thanks to those of you who generously responded to my recent request for old editions of electrotherapy texts that you may have had lying around collecting dust! I now have a better collection than previously, but I do still have editions of the classic Claytons Electrotherapy missing from the series, so if you have something in your library, and it would not cause too many tears to be parted with it, please do let me know. I am always on the look out for texts, so if you have something old, unwanted and which might be of interest at this end, please do e mail and let me know.

NEWS – Electrotherapy Courses

I am trying to be a bit more efficient with running both the Electrotherapy and Tissue repair courses, so to that end, all the Electrotherapy courses are now organised and run through an education organisation (ElectrotherapyUK) – much better as I can get on with the lecturing, research and writing rather than doing loads of courses admin. The details are on the courses page of the web site together with a list of the events scheduled for the next few months. The ElectrotherapyUK web site (www.electrotherapyuk.co.uk) also has all the details you might need if you are looking to set up a course or event. The Courses Manager there is Hazel Hindes, and she can be e mailed on hazel@electrotherapyuk.co.uk. The tissue repair sessions continue to be run through PhysioUK (info@physiouk.co.uk).

Contents

Electrotherapy Survey

This paper came out last year, but might be of interest to those of you who are concerned about relative use of modalities in practice (***Shah, S., et al. (2007). "Availability and use of electrotherapy devices: A survey." Int J Ther Rehabil 14(6): 260-264***).

This survy in some respects does not come up with anything too radical. NHS departments in the South of England were consulted (n=46), and as one might predict, ultrasound was the most commonly available and used modality (nothing changed from previous work by several other authors). Microwave was not available in any of the surveyed departments, and although this is consistent with my own perceptions of UK electrotherapy use, it may not be fully reflected across the country, and certainly may not be true for therapy practice in other countries – by the way, I would be interested to hear about equivalent work based in other countries if you know of anything.

The full list of modalities considered were : ultrasound, TENS, interferential, shortwave (continuous and pulsed) laser and microwave – looking at machine ownership and also usage. Some departments had several of each machine (also not exactly surprising), but it was interesting the several departments had machines that were rarely or infrequently used. Continuous shortwave was the most popular machine not to use (i.e. available but not used) followed by pulsed shortwave and then laser. Interestingly, these tend to be the expensive pieces of equipment – certainly when compared with TENS and other relatively low cost devices, and the authors make comment about this in terms of potential purachasing issues. I published a paper (with M AlMandeel) on the use of pulsed shortwave a year or two back, but that was a national rather than a geographically local survey, though it showed some areas of high use. There appears to be a conflict between the results and the discussionsections in this paper, in that pulsed shortwave was listed as one of the

modalities which was available but not well used, yet in the discussion, it is identified as one of the most commonly available and commonly used modalities – just a numbers issue I am sure, but tease that one out if you can!

Low Intensity Pulsed Ultrasound and Tendon Healing

I have included a steady stream of papers relating to low intensity pulsed ultrasound (LIPUS) in the Electrotherapy Newsletter over the last couple of year, and here is another one from a research group in Hong Kong (***Fu, S. C., et al. (2008). Low-intensity pulsed ultrasound on tendon healing: a study of the effect of treatment duration and treatment initiation. Am J Sports Med 36(9): 1742-9***).

This was an animal based lab study involving 60 rats exposed to various different LIPUS treatment regiemes following middle 1/3 patellar tendon harvesting. It has been previously demonstrated that LIPUS has beneficial effects in terms of tendon repair, and this somewhat complex experimental design set out to determine whether there are significant time based dose factors that come into play – when the LIPUS is started following surgery (day 1, 14 or 28) and how long the treatment phase lasts (2, 4 or 6 weeks). The experimental outcome was primarily determined by mechanical testing and histology. Clearly, the 10 group design (included some placebo interventions) can be difficult to imagine, but there is a useful figure in the paper that makes it readily understandable. The LIPUS dose was at 1MHz and 0,03 W cm-2 using a 2cm diameter probe held in stationary contact with the treatment zone, using a gel couplant. Treatment was for 20 minutes daily, 5 (consecutive) days a week in line with previous work reported in this newsletter. The full details of the method are found in the paper together with histology and mechanical test details. The results (just the essential ones here – there are LOTS of them with a 10 group design) showed that the LIPUS tendons were significantly mechanically stronger than the mock isonated (control) tendons, and that strength increased with time. The best result appears to have been obtained with the 2 week treatment programme, starting on day 1 post surgery. Increasing the treatment duration to 4 or 6 weeks did not provide any additional advantage. Starting the LIPUS at day 14 or 28 did not provide an equivalent advantage over controls. The histology results are similarly described in detail, but the critical findings were that the LIPUS group tendons demonstrated better collagen alignment for the 2 week LIPUS programme starting at day 1. The longer treatment groups and groups that started later did not show this advantage over controls and importantly the group starting LIPUS on day 29 for 2 weeks showed some detrimental effects, and the groups where LIPUS was started in day 1 but continued for 4 or 6 weeks also demonstrated some apparently detrimental outcomes on histology.

The authors provide some insightful comments in the discussion and a very useful comparison with previous studies. The results of this work may not directly transfer to human/clinical work, though there is no direct evidence to say that it would not. LIPUS as delivered in this study, starting on day 1 post surgery and continued at a standard dose, 20 minutes a day 5 days a week for 2 weeks certainly gives the best outcome. Longer treatment programmes to not provide any significant advantage, nor does starting the LIPUS laer in the sequence. Interesting results, and potential clinical value for patients undergoing tendon harvest for various reconstruction procedures – the donor site can cause notable problems, and this might serve to ameliorate them to some extent.

Ultrasound for Muscle injury – Rat Gastrocnemius

OK, another animal study, and I know the criticisms that get delivered with animal studies BUT they do get the fundamental work established and in my (personal) view, that make an invaluable contribution to electrotherapy research. This paper, published earlier in the year in Ultrasonics from a research group in Brazil

makes for an interesting read (***Piedade, M. C., et al. (2008). Effect of ultrasound therapy on the repair of gastrocnemius muscle injury in rats. Ultrasonics 48(5): 403-11***).

Thirty rats were used in this particular work, and each was subjected to a controlled surgical hemitransection of the gastrocnemius. The animals were divided into several groups with a control and a treatment group being the main division. US was started 2 days pot op using 1MHz pulse 1:1 (50%) at 0.57 W cm2 using a gel couplant and a moving treatment head. Treatment was daily for 5 mins. The control and treated animals were further divided into three time groups (4, 7 and 14 days) and 5 animals from each group were sacrificed at each time frame. The outcome measures were based around histology and immunohistochemistry data, and the procedures for both are identified in sufficient detail in the paper. The microscopy work included working out the % of the tissue area which was occupied by collagen and a further test to identify muscle tissue area.

The results are too complex to reproduce in full here as the tissue area was further divided into three zones – so you have treatment and control groups, three zones of tissue and three time frames – and anyway, if I did put the full results in here, you would have less inclination to go to the original paper! At 4 days, there were certainly differences in the appearance of the control and the US treated tissues, with the US group showing more collagen which was thicker and more organised. By 7 days there was more granulation tissue – as one might expect – and both groups showed myotubes, myoblasts and myofibres. There was still a difference in the collagen content and appearance between the control and US wounds, with the US group showing more, thicker collagen with greater organisation. By 14 days, the treated group once again showed more organised collagen. The differences between the control and treatment groups were statistically significant for collagen at almost all stages, and also significant for myoblasts and myotubes at 14 days (US vs control).

The results would support the use of US in this type of lesion, with the treatment group showing more rapid collagen deposition and greater organisation of the same which could account for the greater strength of ultrasound treated lesions (reported in other studies). There is an extensive discussion in this paper, and although I might disagree with some of the comments made, it is useful to read and well worth consideration. Whether this result would transfer directly to the clinical environment remains to be seen. The lesion was 'surgical' and this dose of US relative to the size of the tissue is pretty high, but it certainly raises the issue that there might yet be some benefit in using US for muscle injury, something that several recent research papers have suggested my not be worthwhile. Maybe it is a dose issue (again) and previous studies have delivered an insufficiently high dose to achieve the benefit? Watch this space as they say.

Ultrasound for Rhinosinusitis

This is a report of a clinical trial using ultrasound in an ENT setting – something that in my own experience is not that common. The researchers, based in Iran carried out what is described as a pilot study (that numbers are not that large) comparing an ultrasound group with a control group for this common ENT condition (***Ansari, N., et al. (2007). Physiotherapy for chronic rhinosinusitis: The use of continuous ultrasound. Int J Ther Rehabil 14(7): 306-310***). The authors have previously published in this area with a paper on chronic sinusitis in 2004 and a further paper in 2007.

This chronic condition has no well established effective treatment (according to the authors – I must admit, this is not exactly my specialist area!!!), and the mainstay of treatment is to control infection and to break the chronic disease cycle. Having previously established the benefits of pulsed US, the researchers aimed to evaluate the benefits of continuous US in this study – the logic being that in 'thermal mode' the US might effectively increase the local blood flow to the area which could be considered to be beneficial.

The trial was a single blind RCT design and patients were recruited against a set of established criteria. The US was delivered at : 1MHz, 1 W cm2 for the maxillary and 0.5 W cm2 for the frontal sinuses, continuous mode with treatment times of 5 mins per maxillary and 4 mins per frontal sinus, using a contact gel and moving treatment head. Treatment was 3 x a week for 10 sessions, and those (randomly) allocated to the control group were actually exposed to 'mock' ultrasound, hence the patient was blinded to treatment (although that is a bit questionable with the thermal effects). The outcomes (physician assessed) covered a range of measures including pain, nasal discharge and obstruction, cough, post nasal drip and smell disturbance (known as hyposmia – learn something new every day!). The outcome scoring system was complicated by comparing the % improvement against healthy subjects and rhionsinusitis patients using published data. This was followed by by a questionnaire at 1 month.

The results show that there was a significant symptom improvement in both groups, but the US group were significantly better than the control group. The percentage improvement scores are impressively different being some 86% in the US group and 37% in the controls. There were no negative treatment effects reported. The overall improvement in the US group was better than in the controls. At follow up, 8 of the 10 US group reported no recurrence whilst all patients in the control group reported recurrence. The authors suggest some possible mechanisms for the effects achieved and acknowledge some limitations of the study. The outcomes are good, and I suspect that many patients with this chronic condition would be pleased to achieve this level of improvement. It is a shame that a longer follow up was not possible, because the maintainence of the improvement might just be the critical factor that determines whether it is actually worth doing in routine clinical practice.

Ultrasound for Osteochondral Plugs

Amongst the many enquiries that I get weekly, there has been a growing number of people asking whether ultrasound has any effect on cartilage repair – well apart from any other information that I had, this paper might help those with an interest in this field (***Cook, S. D, et al. (2008). The effect of low-intensity pulsed ultrasound on autologous osteochondral plugs in a canine model. Am J Sports Med 36(9): 1733-41***). The basic argument is that there is an increasing interest in the use of chondral plugs in the management of cartilage defects and lesions. Ultrasound is known to stimulate fracture repair, and the evidence would support in principal, its use as a cartilage repair stimulation modality – which is in effect what this research group from the USA evaluated.

This is animal model experimental work, using dogs rather than the more commonly employed rats and rabbits. Essentially cartilage deficits were created in both knees of 18 dogs, with one knee being treated post operatively with low dose US (LIPUS again) on a daily basis and the other knee not. Some animals were sacrificed at 6 and some at 12 weeks with the cartilage trauma site evaluated in both gross visual and histological terms. The cartilage lesions were created by a trephine which made a 5mm plug and a gap of about 1.5mm between that plug and the adjacent cartilage (there are photos and a full explanation in the main paper). 2 such lesions were made in each knee on the medial condyle, and in all animals the (R) knee was treated with US and the left acted as control.

Seen any interesting papers?
Is there a paper that you have written and ought to be reviewed here?
E mail and let me know electronews@electrotherapyonline.co.uk

The US applied was a LIPUS application – mentioned already in this issue – using a predictable 1.5MHz, 0.03 W cm2, pulsed with a 20% duty cycle for 20 minutes daily. Treatment was started on post op day 3 and was delivered 6 days a week. Treatment was directly over the surgical site and a gel contact was used.

The outcomes include visual (photographic) and histological examinations. The appearance was scored using a specific weighted score system with a max score of 8, and the histological changes were also scored with a max of 16 points (details of both score systems are provided). Sacrifice of some (n=6) dogs at 6 weeks and the remaining (n=12) at 12 weeks enabled a time based analysis in addition to a final outcome evaluation. There are lots of results, and on the basis that most people reading this are not going to be into histology in a BIG way, I will summarise – the details as ever are in the original paper. The overall gross (visual) scores were significantly different at 6 weeks in favour of the LIPUS group (but not, interestingly enough @ 12 weeks). The histology scores were significantly different @ both 6 and 12 weeks in favour of the LIPUS treated lesions (the full results include a breakdown of which histological changes were sig and which ones were not – page 1737 if you want them).

There are some interesting points raised in the discussion, including a consideration of whether US applied in this way to the human knee would / could actually reach far enough into the tissue to do any good – worth a read even if you don't get too excited about the histology bits. There is certainly potential here. Cartilage repair is becoming more widely considered, and I come across an increasing number of surgeons and therapists talking about it – it is heading for the mainstream if not there yet. IF the application of LIPUS can help the repair of the cartilage defects, the reduction in immobilisation time and swifter rehab overall it is likely to move into and stay in mainstay therapy. This evidence makes a very useful contribution towards that end.

Kilohertz and low frequency stimulation for Muscle Contraction

The first of the electrical stimulation papers in this issue is from Physical Therapy and is a report from a research group based in Israel (***Laufer, Y. and M. Elboim (2008). Effect of burst frequency and duration of kilohertz-frequency alternating currents and of low-frequency pulsed currents on strength of contraction, muscle fatigue, and perceived discomfort. Phys Ther 88(10): 1167-76***).

The argument is well made that maximally effective stimulation of muscle contraction with minimal discomfort is clinically useful (several other authors have considered the same issues over the years, and Laufer has published on the same topic previously). The basic comparison in this work was the difference in maximal contraction, fatigue and discomfort using a low frequency pulsed current and 3 different kilohertz based alternating currents using a group (n=26) of asymptomatic volunteers.

The wrist extensors were employed in this work (often it is the quads) and each participant was subjected to all 4 stimulation modes on separate occasions. There is a useful summary of the background literature and physiological issues relating to kilohertz and low frequency stimulation, and I know that there are other papers in this same area which have recently been reviewed are will be out there soon. Alex Ward (mentioned in previous issues) has published extensively on this topic and is widely cited in this paper. Discomfort for the patient (research volunteer in this case) and fatigue are both salient factors in relation to strong muscular contraction based electrical stimulation. Producing maximal contraction with minimal discomfort and minimal fatigue seems like a reasonable intention in the clinical environment. As we all know, motor nerve stimulation can be achieved with either low frequency stim or a kilohertz stim which is packaged or modulated or burst in some way or another (sometimes referred to in therapy as 'medium frequency' currents – not a good term at all actually). The apparent advantage of these kilohertz frequencies is that they produce a lower discomfort level due to the complex "resistance" of the skin (actually a capacitive barrier rather than

a resistance). The Russian Current (used for a while out there now) operates at 2.5kHz and is surged (or burst) at 50Hz with a 50% duty cycle. It is the 50Hz bursting that is (nominally) responsible for the nerve stimulation. OK, sorry – just realised this is turning into a textbook chapter . . . . . you can read the intro yourself – or better still, look at some of the recent reviews and discussions on the topic – loads of references provided here if you want to chase them up.

The 4 different stimulation modes are detailed in the paper – summarised nicely in a table – but essentially compared one low frequency stim (50Hz @ 200ìs) with three different kilohertz stimulations – all based on a 2500Hz carrier, all with a 200 ìs duration, but using either a 50% or a 20% duty cycle and varying interburst durations. There was a minimum of 48 hours between test sessions and the subjects were paid for their efforts (don't get any ideas if you sign up at my end!!!). The non dominant wrist extensors were tested and the interventions were applied in a random sequence, with the subject blinded with regards the stimulation applied (all stimulation modes were delivered using the same device).

The test sequence was complex and is detailed in the paper with a summary table and detailed description. It included a test of maximal voluntary contraction, a test of maximal electrically induced contraction, a fatigue test and an evaluation of perceived discomfort.
The results : There was no significant difference in the strength of the contractions induced by the different current forms when expressed as a % of the max voluntary contraction for each person. The fatigue tests provide a series of results, but in summary, the low frequency pulsed current produced the least amount of fatigue when compared with any of the kilohertz currents. The fatigue brought about by the kilohertz currents did vary between modes, and it appears to be most strongly related to the total number of pulses delivered. The participant discomfort ratings showed that the kilohertz (20Hz 1:4) was the worst rated. There are more results if you want to look at the detail and an extensive discussion which deserves a read. The authors conclude that the low frequency pulsed mode was the least fatiguing and the Russian Stimulation the worst in this regard, and furthermore that when considering the combination of contraction strength, fatigue and discomfort, the low frequency pulsed currents comes out with the overall advantage. There are some inconsistencies between these results and those previously obtained by others (all acknowledged in the text) and the outcomes of this work may generate some further discussion – but as it only came out in the last 10 days, I guess you will need to keep your eye on the correspondence pages to see what that might be! Good paper, well worth a read of the full work, especially if electrical stimulation of muscle activity is something that you are into.

Functional Electrical Stimulation in Spinal Cord Injury

There is a wealth of literature out there relating to Functional Electrical Stimulation (FES) and I tend not to cover a lot of it in this newsletter, but this paper from earlier in the year from researchers in Glasgow provides some interesting data (***Wallace, L. and J. McQueen (2008). Acute phase functional electrical stimulation for the upper limb after cervical spinal cord injury. International Journal of Therapy and Rehabilitation 15(4): 230-234***).

It is a case study based paper rather than an RCT or other experimental design – and as mentioned previously, these papers make a valuable contribution to knowledge and provide indicators for future research potential. This particular study considers the use of FES in a young man (17) with a C4/5 complete tetraplegia.

The initial assessment showed some muscle activity at C4 levels, but nothing below C4/5 bilaterally and no sensation below C4.

Stimulation was applied with an Odstock stimulator (4 channel) set at 30Hz, using a 10 second contraction period followed by 20 second rest phase. Channels were alternated in their stimulation. Treatment was started in biceps (bilateral) and at this point the patient was still in the acute post injury period and on bed rest (still medically unstable in fact). The initial biceps 'flicker' became an Oxford grade 3 which is sufficient to allow active elbow flexion (2 weeks) at which point the stimulation emphasis was shifted to the forearm extensors. Stim was applied daily for 20 minutes over a 4 week period.
Therapy was continued after 6 weeks in a specialist hand therapy unit as he was now sufficiently stable to attend. By discharge at week 40, the assessment findings show a considerable gain in muscle activity when compared with the initial assessment findings with decent activity in deltoid, biceps and for pro and supination – which clearly provided a level of function and some independence.
Given that this is a case study, and also given that the patient was exposed to a range of 'normal' rehabilitation and treatment, it can not be claimed that the outcomes were a direct result of the FES (the authors fully acknowledge this by the way) BUT it does raise the issue about the potential value of early FES intervention – from the inpatient, confined to bed stage – rather then the more commonly employed 'wait till get to rehab' stage. Interesting read for any involved with SCI and / or FES work.

Dexamethasone Iontophoresis

I still have not done much on the web pages on Iontophoresis (though it remains on my list of things to do), but have put several items into the newsletter on it over recent issues. This paper from a UK group based in Bath looked to identify the optimal stimulation parameters for the transmission of dexamethasone phosphate (Dex-Phos) across (pig) skin. The researchers are based in a pharmacy/pharmacology unit and therefore the bias of their work is not primarily on the clinical aspects of iontophorses, but never the less, provides some important data for anybody who does use this technique in practice (***Sylvestre, J. P. et al. (2008). In vitro optimization of dexamethasone phosphate delivery by iontophoresis. Phys Ther 88(10): 1177-85 [plus a discussion 1185-7***]).

The basic idea of iontophoresis (forgive me if this is kindergarten stuff to you – not trying to be patronising) is to use a small (<0.5mA) current to enhance the transport of materials across the skin and thus into the tissues. In order for this to be effective, the material to be transported needs to be made up of charged and polar molecules. The introduction to this paper actually provides a nice overview of the mechanisms and background scientific concepts if you need a recent and referenced summary.

Using an in vitro set up, varying solutions of the Dex-Phos drug were manipulated in an experimental chamber, using pig skin between the two sides of the chamber. It has been argued that when using iontophoreses to enhance the transport of Dex-Phos the anode should be used, but the authors reason that at physiological pH, Dex-Phos is negatively charged and therefore delivery from the cathode should be more effective. They also investigated the mechanism of transportation (electromigration / electroosmosis). The set up is described in considerable detail in the paper, and I will not try and explain it all here or else this section would be longer than the original text! The work evaluated not only the effect of electrode polarity, but also the composition of the donor solution and the electromigration and electroosmosis effects. The results show that a cathodal delivery is clearly preferable in terms of effective transport, and that the concentration of the Dex-Phos in the donor solution (by a factor of 4) makes no significant difference to the transportation. The authors conclude (this is a very brief summary of their actual conclusions) that the cathode should be used for this technique, that the solution used with the Dex-Phos does make a difference and the better option is to use a solution with no background electrolyte. Whilst this experimentation is based around an in

vitro model, the authors argue that the results should transfer to the clinical setting, and if iontophoresis is something that you use clinically, and especially if Dex-Phos iontophoresis is in your repertoire, then that paper should be an essential read, as it should be if you are studying iontophoresis as a technique as a part of you training / education programme.

Radiofrequency Microtenotomy and Tennis Elbow

Tennis Elbow (or lateral Epicondylitis or lateral epicondyalgia or . . . .) is one of those problematic lesions for which many therapies have been tried with mixed results, none of which are that impressive or consistently effective (see the Poltawski et al (2008) paper mentioned in the News section of this issue). This research group from Norway evaluated the benefits of a 'new' technique – radiofrequency microtenotomy) against a standard (tendon release surgery) treatment (***Meknas, K., et al. (2008). Radiofrequency microtenotomy: a promising method for treatment of recalcitrant lateral epicondylitis. Am J Sports Med 36(10): 1960-5***).
I know that doing surgery is not part of what most of you do on a day to day basis, and in fact, I doubt that radiofrequency microtenotomy will be either, but the work is interesting in that it does evaluate the benefits of an intervention for a problematic lesion that as therapists, we do see with some regularity.
24 patients were divided into a surgery group (extensor tendon release and repair) and a microtenotomy group and were assessed pre intervention and then followed up through to 3 months post intervention using thermography and pain as primary outcomes.

Existing treatments, ranging from BoTox through to Shockwave (40 of them are identified) provide mixed results, and only a relatively small number go on to reach surgery. It is suggested here that as LE is a degenerative condition in which stimulation of the angiogenic response is an intended treatment outcome (which would be consistent with some, if not all the literature), the use of the microtenotomy should be able to have a significant beneficial effect as it brings about an inflammatory response followed by angiogenic healing (which is something that we are looking at in relation to other chronic tendinopathies).

The minimum duration of symptoms was 12 months, though the mean was closer to 2 years in both groups, and conservative therapy (NSAID's, steroid injections and physio) had been tried in all patients (and by default had failed). Pain, grip strength and an qualitative assessment questionnaire were used at time = 0 and then 3, 6 and 12 weeks post operatively. The thermography was not completed on all patients (18/24) – and although the procedure was described, the reason for not assessing 6 patients was not identified (or I missed it!). Both the surgical and microtenotomy procedures are described in adequate detail in the original paper.

The results : Pain in the operative group had decreased significantly by the 6 week time frame and decreased further by the 12 week mark. In the microtenotomy group, the pain reduction had reached significance by 3 weeks and reduced further at the 6 and 12 week points. The longer term follow up (telephone between 10-18 months) showed the pain reduction was maintained in both groups, but there was no significant difference between them. The grip strength changes in the operative group increased, but not by a significant amount. In the tenotomy group, there was a larger improvement, which did reach significance. The subjective (questionnaire) scores improved for both groups, both were significant , but the microtenotomy changes were greater (improvement). The return to work time was slightly better in the microtenotomy group, but the difference was not significantly different from the operative group. The thermography image changes are described. This is a relatively novel assessment mode (something we are trying in our research unit) and although the findings show what appears to be a normalisation of skin temp post intervention, and the disappearance of the 'hot spot' seen prior to intervention, the results are not easy to quantify at the moment, though the descriptive analyses provided are useful.

The demonstration that both procedures were effective means that the new microtenotomy is at least as good as the surgical intervention, but given the better improvement scores for both pain reduction and the restoration of grip strength in the microtenotomy group, this new procedure appears (from this study) to have the advantage. It may well be that the microtenotomy proves to be the more popular technique in future. We are currently evaluating the effectiveness of microcurrent therapy for this condition, and it will be interesting to compare a new conservative treatment outcome with these surgical results. Watch this space I guess.

Foetal exposure to electric and magnetic fields

I took a serious look at the literature on electromagnetic field exposure for therapists who are pregnant some years ago and have tried to keep an eye open for other developments since then. This paper by Cech et al (from Austria) (***Cech, R. et al. (2007). Fetal exposure to low frequency electric and magnetic fields. Phys Med Biol 52(4): 879-88***) further considers foetal exposure and relative risk. Cech has published extensively in this area, though is not primarily concerned with shortwave / pulsed shortwave devices per se.
A lot of this work is done (understandably) using computer modelling, and for this analysis a 'new' model (SILVY) of a pregnant woman was developed and the current assumptions and suggested field strength maxima were tested. The arguments as to why a new model is needed are comprehensively outlined and a review of the state up play to date is included – and although a bit mathematical for most, it would be useful for anybody with a specific interest in this field (sorry about the pun). The development of the SILVY model is detailed along with the source data (tissue conductivity) and the assumptions made along the way. Exposure of the model to low frequency electric and magnetic fields is then undertaken and the results compared with current guidelines (ICNIRP 1998).

The results compare favourably with those obtained by other models in terms of similar values etc. The standard energy exposures were multiple, with magnetic fields tested in frontal, saggital and vertical orientations and the electric field in vertical orientation. The electric field produced higher values than the magnetic fields in any orientation. The 'hot spots' for the electric field were centered around the neck, knees and ankles, but this is most likely due to the smaller cross sectional values at these points. The frontal magnetic fields gave highest values in the trunk. Event if the numbers are not too exciting for you, the figures provide a wonderful 'map' or profile of energy exposures and concentrations in the tissues. The table (p885) shows the detail of the three magnetic field induced current densities in the mother and the foetus together with the electric field data.

The overall exposure in the mother part of the model fell within permitted levels, but it is interesting that in the foetus, there were induced currents that were higher than expected and above the recommended basic restriction (which is at 2mA m2) with values of 3.32mA m2).

This is NOT a model of what happens when a woman who is pregnant is exposed to shortwave / pulsed shortwave / other high frequency energies – so don't start to worry about going near a shortwave etc when pregnant. The model might be useful as a means to calculate such values, and would make for a great project for anybody with a mind-set that bends in this particular direction. The model is not that refined, and numerous assumptions are made – such as there is no interaction considered between the electric and magnetic fields, and the fact that the SILVY model is based on data from one individual who was pregnant at 30 weeks (I think), BUT never the less, it does provide a possible advancement in computer modelling of electric and magnetic fields and the way that they might affect the mother and the foetus during pregnancy.

Electric Fields and Nerve Regeneration

Betty Sisken, the second author in this paper, is a researcher whose work I came across a couple of decades ago in relation to nerve growth, endogenous electric and applied electric fields. She is clearly fully involved with this work, with many publications over the years and a recent paper (***Greenebaum, B. and B. F. Sisken (2007). Does direction of induced electric field or current provide a test of mechanism involved in nerve regeneration? Bioelectromagnetics 28(6): 488-92***) develops the evidence a bit further (you are strongly encouraged to do a search using Sisken as a search term if electrical or magnetic stimulation of nerve repair or regeneration is an interest area for you).

This particular paper looks at the specific issue of magnetic field orientation in relation to nerve regeneration effects. Pulsed and other time varying magnetic fields are well established in the research literature as being an effective means to enhance nerve repair and regeneration. Although spinal cord repair is understandably an aspiration here, my more immediate (personal) excitement comes from the peripheral nerve work – something that I think on the whole we do no use pulsed electromagnetic fields to treat even though the evidence is pretty good out there.
The authors illustrate clearly how, if the magnetic field is applied with a different orientation in relation to the body, the induced fields and therefore currents will also have a different orientation. Some of these will be more advantageous than others, and they go on to discuss how, depending on the mechanism of effect, this might make a big difference to treatment outcome. If neurite growth follows field orientation, when it comes to nerve repair and regeneration work, the orientation of the applied magnetic field should make a big difference to outcome. Magnetic fields applied in a perpendicular mode should be better in this respect. The paper describes a model and proposed experimentation. It does not come up with earth shattering results (yet) BUT it is a great read if using magnetic fields in therapy for nerve repair / regeneration is your thing. I have been suggesting for some while that magnetic type therapies have a lot of unrealised potential. IF they can be used to induce small electric currents in damaged / repairing tissues (whether nerve or anything else), they should have a phenomenal capacity to enhance the tissue response. This has already been well demonstrated in bone, and the work of Sisken et al (including but not restricted to Walker, McCaig and Song) takes the evidence and argument to a more advanced level. I will try and produce an overview of the magnetic therapy evidence at some point – it has been on my 'to do' list for some while, but in the meantime, have a read through this one and follow up on the key reference material, and you will get a very good feel for where we are at the moment.

Cryotherapy and Achilles Tendon microcirculation

Time for a change of tack, and to take a wander into the world of cold therapy. I have included cryotherapy papers in several recent issues, and although not mainstream 'electrotherapy' per se, it does fall within the remit of Electro Physical Agents – becoming a more encompassing and appropriate terms for these modalities – and hence my justification for their inclusion.

Knobloch should be a reasonably familiar name to any of you who search the literature in this area, or indeed who scan through this newsletter (I did something on microcirculation and Achilles tendinopathy an issue or two ago). The team are based in Germany, and this paper (***Knobloch, K., et al. (2007). Intermittent KoldBlue cryotherapy of 3x10 min changes mid-portion Achilles tendon microcirculation. Br J Sports Med 41(6): e4***) again looks at TA microcirculation, but this time in response to a cold therapy as opposed to eccentric exercise.

This was a lab based study involving 30 asymptomatic subjects (12M 18F) whose characteristics and demographics are clearly identified in the full paper. They were subjected to 3 x 10 minute application of a particular cold bandage and TA microcirculation was measured during and after each application (during a single

session). The use of cold therapy in numerous areas of physiotherapy (and many other 'therapies') is well established. It has been previously shown that intermittent cold application can be more effective than a single 'long' treatment, and this study looks specifically at 3 x 10 minute applications in terms of TA microcirculation (capillary blood flow, oxygen saturation and postcapillary venous filling pressure).
Measurements were taken at both 2 amd 8mm tissue depths using a combination of laser Doppler and flowmetry (which I described in relation to their earlier work as I recall). The laser Doppler measures (indirectly) blood flow – looking at mean velocity using back scattered light. They are reported in 'arbitrary' or 'relative' units (for reasons identified in the paper).

The cold therapy bandage, which unfortunately is just about the weakest part of this paper, is not fully described. It was applied for 3 x 10 minute periods with a 10 minute rest between each.

The results (lots of them, summary only here) showed that there were big and very fast reductions in capillary blood flow which were statistically significant each time the cold bandage was applied both at the 2mm and 8mm depth. There was no reactive hyperaemia responses during the rewarming (interval) periods. The oxygen saturation levels also dropped significantly during each cold application. The oxygen saturation changes at depth were much smaller, though still demonstrable. The postcapillary venous filling pressures responded in an almost identical fashion to the oxygen saturation with significant decreases during the cold application and return during the intervals. The mean change in bloodflow during the cold therapy was just over 70% which is a pretty decent sized change, and these chages were happening swiftly (like about 20 seconds) of the cold being applied.

The discussion proffered by the authors tries to put these changes into context in terms of what is known from previous research and also in relation to 'therapy' and therapeutic effects. The further development of this work to include patients with Achilles tendinopathy appears to be planned, and would make for a fascinating extension, with hopefully, direct clinical relevance. In the meantime, the demonstration that this particular cold therapy application has strong effects on superficial and deep TA microcirculation adds considerably to the evidence and should contribute usefully to the vascular / non vascular debate about what actually happens in the TA both in health and disease. There are limitations to this research, and in my own view, it is a real shame that there was not more information about the cold therapy bandage and its application (maybe I should just know these things??). A useful paper and I look forward to the follow up with a patient group.

The last 2 papers in this issue relate to electroacupuncture rather than the usual tissue repair papers that I often finish up with. The recent Electroacupuncture book by Mayor (details on the web pages) shows just how much evidence is out there covering this subject. My own database has thousands of papers and experimental reports for this topic, so here are a couple of papers that might be of interest – one from last year and one from earlier in this one

Electroacupuncture and inflammation

Li et al, a research team based in the USA report the outcome of some animal experimentation (rat) looking at how electroacupuncture might be able to influence inflammatory events and oedema (***Li, A., et al. (2007). Corticosterone mediates electroacupuncture-produced anti-edema in a rat model of inflammation. BMC Complement Altern Med 7: 27***).

There were in fact 3 different experimental elements here. The rats were injected into their hind paw to bring about an inflammatory response. Electroacupuncture (EA) was applied at 10Hz, 3mA and 0.1ms pulse duration, on 2 occasions for 20 minutes, the first application being immediately after the paw injection and

again 2 hours later. The experiments looked at plasma corticosterone (CORT) to see if the EA influenced its secretion, secondly looking at the effect of EA on animals with their adrenal gland removed and thirdly looking at the effects of EA on oedema by means of a glutocorticoid receptor antagonist. There were not that many rats used in the work, and therefore the numbers in each experimental sub group were limited (7-8 per group) which limits the power of the analysis to some extent, but none the less, still provides some useful data.

The CORT experiment used 4 groups of rats – one getting the inflammatory jab and EA, one getting the inflammation and sham EA, one getting just the injection and one getting just the EA. The results show a VERY strong reaction to the inflammation and real EA group with increases immediately post injection and at 2 hours later. The EA applied to the rats in whom the inflammation had not been induced was not significantly different from the control response.

In the adrenal group experiments, adrenalectomy rats were divided into 2 groups – one getting the paw injection and real EA and the other getting the paw injection and sham EA. Paw oedema and paw withdrawal latency test were used to assess the outcomes at 2 and 5 hours post injection. The EA had no effect on paw oedema in the rats who had their adrenal glands removed, thus suggesting that the mechanism of action was related to adrenal activity (the antioedema effect having been previously established when the adrenals were intact). The EA significantly inhibited hyperalgesia in the adrenal compromised rats.

In the final group experiments, a glutocorticoid receptor antagonist was injected into the paw 15 mins before the 'irritating' injection. Paw oedema was evaluated using the same method as above. The results (very briefly) showed that the real EA did minimise paw oedema but when the antagonist had been used prior to the irritating injection there was no difference to the control condition, showing that the antagonist blocked the effects of the EA.

At the end of the day this (animal) work shows that EA stimulates the adrenal gland and thereby increases levels of CORT by which it has an effect on inflammatory responses in the tissue. EA has been used for a long time in the clinical environment to achieve these effects, and this is a nice demonstration of a probable mechanism. There is more work to do, and the animal model demonstration needs to be confirmed in the human/clinical environment and also with patients with a range of inflammatory conditions, but it is a good addition to the evidence base in the meantime.

Acupuncture, electroacupuncture and low back pain

The last paper for this issue looks at both acupuncture, electroacupuncture, low back pain and sciatic nerve blood flow (***Inoue, M., et al. (2008). Acupuncture Treatment for Low Back Pain and Lower Limb Symptoms-The Relation between Acupuncture or Electroacupuncture Stimulation and Sciatic Nerve Blood Flow. Evid Based Complement Alternat Med 5(2): 133-43***).

Inoue, based in Japan, is no stranger to publishing in this field, with numerous papers to his credit. This is not a 'quick' paper – runs to 10 pages – but describes both clinical and animal experimental work. I will cov-

Seen any interesting papers?
Is there a paper that you have written and ought to be reviewed here?
E mail and let me know electronews@electrotherapyonline.co.uk

er the essentials here, but unless my text also runs to 10 pages, we are not going to get anywhere close to the full detail.

Patients with spinal canal stenosis, patients with lumbar disc herniation are both reported. The spinal stenosis treatments were of three different types : acupuncture at the appropriate paravertebral point relative to the lumbar stenosis : electroacupuncture at the pudendal nerve : electroacupuncture at the nerve root. EA was applied at a stimulation frequency of 2Hz for 10 minutes at a sensory level. Treatments were carried out between 3 and 5 times at weekly intervals. Needle positions and techniques are full described. Lower limb pain, dysesthesia and walking distance are the key issues presented by the patients being treated. The main results in this investigation showed benefits for the acupuncture group (about 6 out of 10 cases). The pudendal nerve point EA group showed improvement for 2 out of 10 with low back problems and 8 out of 11 patients with lower limb problems. EA to the nerve root appeared to have a very strong initial effect (first session) for all outcomes with further improvement over the next 3-5 sessions. Improvement was maintained at a 3 month follow up period.

The herniated lumbar disc group were also exposed to the same 3 interventions (acupuncture paravertebral, EA pudendal nerve, EA nerve root). The paravertebral acupuncture gave improvement in 3 of the 6 low back pain patients, 5 of the 12 lower limb pain group and 3 of the 9 lower limb dysesthesia patients. The patients who did not improve with this intervention were then exposed to the pudendal nerve stim, 2 or the 3 low back patients improved, 3 of the 7 lower limb pain group improved and 3 of the 6 lower limb dysesthesia improved. Three patients were exposed to the sciatic stimulation, and as with the stenosis group, there was a strong effect after the first session and continued improvement thereafter and maintained at follow up.

This was a complex, overlapping study with lots of results. I have not tried to reproduce them all here (I am not just being lazy!). The interested reader is well advised to go get the original paper – this is an easy enough publication to access for free (try http://ecam.oxfordjournals.org/ if you have not done so before). The rat study which is also reported included acupuncture stimulation of the lumbar muscle, electrical stimulation of the pudendal nerve and electrical stimulation of the sciatic nerve, looking at the effects of each intervention on sciatic nerve blood flow. With the lumbar muscle acupuncture, there was a mixed outcome with some showing an increase (33/58), some a decrease and some no change. With the pudendal nerve stimulation (3 animals) showed an increase in sciatic blood flow starting almost immediately after the pudendal stimulation had started, peaking at about 10 seconds. Flow decreased thereafter, but was maintained at a higher level than baseline throughout. Once the stimulation had stopped, it took little time for the sciatic flow to return to baseline. The sciatic nerve stimulation group (n=5) showed an almost identical response as the pudendal nerve stim animals.

There are several clinical implications suggested by the authors. For clinical conditions, it is suggested that local (paravertebral) acupuncture is used as the first approach. If this does not work or is not sufficiently effective, then move to pudendal nerve stim, and then on to nerve root activity for the final non responders. The rationale for this is identified, though I have no doubt that some might want to challenge it! It is suggested that part of the mechanism of action of these interventions is an effect on local sciatic nerve blood flow.

There is more to this paper than I can describe in a couple of paragraphs, and I have no doubt that I have missed out some of the critical bits that you want to read, but it is an open access, free, online journal, so you can very easily get access to the full original script and see for yourself. Enjoy!

OK, so that will have to do for now. There are still a LOT of papers on a pile on my desk – it seems to grow faster than I can get the papers summarised and included in the Newsletter. I am trying to maintain an out-put of 4 issues a year, and am trying to keep it free at the point of use – thank you to the sponsors – EMS Physio for enabling it to stay that way. If you have any specific papers that I appear to have missed, or that you feel need to be included, please do get in touch and tell me about them. E mail (t.watson@herts.ac.uk) is just about the best way to reach me, but please don't be offended if I don't reply immediately as the e mail inbox gets pretty flooded at times with requests for information. Until the next issue, have fun!

Regards

Tim

Electrotherapy News is Sponsored by EMS Physio