Electrotherapy News

VOLUME 2 | ISSUE 1 | APRIL 2006

Sponsorship

Great News – well, for me anyway – both the Web Site and the Electrotherapy Newsletter have been generously sponsored by two of the electrotherapy companies I have been working with for several years and therefore both are safe – for the moment at least! SKF Services have sponsored the newsletter and PhysioMed have sponsored the website. Just in case you were wondering, the content of both is safe and there will be no change to their style or independence – something for which I am grateful. It is flattering to know that both 'e electrotherapy' routes are so popular, but it was getting to be a bit of a financial burden. One less thing to worry about for the immediate future at least. Thanks again to both.

2005 Reference List

In case you havn't noticed it on the web site, there is an updated 2005 reference list (view on line or download). It is not claimed to be a comprehensive list of everything published in electrotherapy over the last year, but may be of interest to some of you who are scurrying around for papers and are looking for a swift update. There are now over 60,000 references in the database and I am considering putting out modality based lists in addition to the 'publication by year' lists. Would be interested to hear any comments on this.

Recent papers . . . . .

TENS for OA of the Lower Limb

A review paper by Brosseau et al from 2004 may be of some interest to those of you working with TENS. It is a nicely written meta analysis [**Brosseau et al 2004, Physical Therapy Reviews 9;213-233 ; Efficacy of transcutaneous electrical nerve stimulation for osteoarthritis of the lower extremities: A meta-analysis**]. The outcome of the review was that conventional, acu-

puncture and burst mode TENS have some benefit over placebo TENS for several aspects of OA – most especially pain and pain related symptoms. Dig around in there, and you will find some interesting comparisons and you may well come across some TENS related articles that you previously missed.

There were several Laser Therapy papers out last year and a couple of good ones at the start of this year, so we can start this issue with some laser stuff . . . .

Laser and Ultrasound in Tendon Healing . . . . .

A paper by Demir et al in 2004 [**Demir, H. et al. (2004) Comparison of the effects of laser, ultrasound, and combined laser plus ultrasound treatments in experimental tendon healing Lasers Surg. Med. 35(1): 84-89]** worked on rat model to try and establish the effects of low intensity laser and low intensity ultrasound using a randomised controlled design. The Achilles tendon was systematically traumatised and treatment started on day one post injury. There were multiple experimental groups (Real US, Sham US, Real Laser, Sham Laser, US and Laser, Sham US and Sham Laser. The US was at 1MHz, continuous, 0.5 W/cm2 for 5 minutes daily (which I appreciate some of you would consider to be somewhat higher than a 'low dose') and the Laser was at 904nm, 6mW mean power, 16Hz pulsing frequency, 1 J/cm2 for 1 minute. Animals received up to 9 days treatment with some animals from each group sacrificed at intervals before that for time series analysis. Hydroxyproline levels and tendon breaking strength were used as an outcome measures. The results (brief summary – look at the original paper if you want the full analysis) was that the hydroxyproline levels were significantly greater in the treatment groups compared with the control groups ($p<0.05$). There was some evidence that the US plus Laser group gave the best result of the treatment groups, but this was not a significant difference. When it came to the breaking strength, again, all the treatment groups were significantly better than the controls, but there was no significant difference between the treatment groups. The overall outcome was that US, Laser and Combined US + Laser were all effective at increasing the collagen content of the repairing tissue, and the strength of that tissue, but that there was no significant difference between the treatment groups. Nice paper and well worth a read of the original.

Another Rat Achilles Tendon paper . . . .

There seems to be a bit of a flurry of rat TA model experimental work around at the moment, and another paper along this line from last year **[Fillipin, L. et al. (2005). Low-level laser therapy (LLLT) prevents oxidative stress and reduces fibrosis in rat traumatized Achilles tendon. Lasers Surg Med 37(4): 293-300]** investigated the effects of low level therapeutic laser on oxidative stress and fibrosis following an impact trauma. Four experimental groups (Control / Trauma / Trauma plus 14 days laser / Trauma plus 21 days laser) were used. The laser was delivered with 904nm, 45mW mean power, 5 J/cm2, 35 seconds daily. The application of the laser for 14 or 21 days gave a clearly different tissue profile to the trauma but no treatment group. There were fewer histological abnormalities in the treatment groups. Oxidative stress is essentially the result of damage to cells derived from reactive oxygen species that occur during inflammation. The oxidative stress indicators for the traumatised but non treated group were very significantly higher than for the control group (by about 300%) but in the laser treated groups, the levels were not significantly different from the controls. Laser therapy appears to influence the oxidative stress reactions following injury and this may be an essential component of how it can be therapeutically valuable. This is a good paper, but it does not necessarily constitute easy bedtime reading for many of us.

Laser, Achilles Tendon – must be a fashion thing . . . . . but humans this time

Bjordal has come up with several excellent papers over the last few years, and the latest offering from that stable follows along the same lines (**Bjordal, J. et al. (2006) A randomised, placebo controlled trial of low level laser therapy for activated Achilles tendinitis with microdialysis measurement of peritendinous prostaglandin E2 concentrations. Br J Sports Med 40(1): 76-80**). The basic argument is that laser therapy is capable of influencing the inflammatory state, and this randomised, placebo controlled trial involved a relatively small sample of human subjects (n=7) with bilateral Achilles Tendinitis (therefore n=14 tendons) using a 904nm laser delivering 1.8J per point (x3) giving 5.4J per treatment with a power density of 20mW/cm2, pulsed at 5000Hz, comparing the outcome with a placebo treatment. A raft of outcome measures were utilised including ultrasound measures including blood flow and tendon thickness, prostaglandin E2 concentration from the tendon, and pressure pain threshold using algometry. The pressure pain threshold significantly increased after treatment, the prostaglandin concentration decreased in the laser group but increased in the placebo group (significant). There was a change in blood flow (pre to post) but the authors do not make any radical claims that this was a direct effect of the laser therapy – as it may well be due to the 'rest' during the experimental procedure.

The experiment only used a single laser treatment, and the authors acknowledge that this is a potential problem with the design, but as the prostaglandin was collect by an invasive procedure, it is understandable eh? The results indicate a reduction in the intensity of the inflammatory response in the period following the intervention, though the follow up was of limited duration. Some interesting arguments included with regards the inflammatory nature (or not!!) of Achilles problems, a subject that has been the subject of several papers in recent years, and referred to in previous newsletters.

Laser . . . . Nitric Oxide . . .

Many of you will recognise Karu as being one of the key researchers in the field of laser therapy, and she published another paper last year (**Karu, T. et al. (2005). Cellular effects of low power laser therapy can be mediated by nitric oxide. Lasers Surg Med 36(4): 307-14**). It was a cellular (in vitro) experiment, so I'll not go into too much detail here, but suffice it to say that nitric oxide activity is also pretty popular at the moment with regards inflammation, injury and repair, and this paper may well provide a useful start point for other work, and also help to elucidate the mechanism by which laser therapy might achieve its effects. Nitric oxide (NO) is effectively a free radical involved in numerous processes and there appears to be a relationship between laser therapy and NO activity. The results are complex, but certainly suggest that part of the mode of action of laser therapy is related to NO activity, and the use of NO donors (as in this work) modifies the outcome of the laser therapy. For those of you that like cell studies, you'll love this one. Those that are less keen might want to give it a miss.

Shortwave . . . that will make a change

Hot off the press this one : **Jan, M. et al. (2006) Effects of repetitive shortwave diathermy for reducing synovitis in patients with knee osteoarthritis: an ultrasonographic study. Physical Therapy 86(2): 236-44**. The aim of the study was to assess whether repetitive shortwave treatments were able to influence the synovial inflammatory response in patients with OA knee using ultrasonography as a key outcome measure – but I guess you could have worked that out from the title! There were three groups in the study . The shortwave group (n=11) a second shortwave group who received NSAID's in addition(n=10) and a control group (n=9) who received no treatment. A diagnostic ultrasound procedure was ultilised in order to determine the synovial thickness

at several points around the knee. Patients received 10, 20 or 30 shortwave treatment sessions. Synovial thickness was reduced after 10 treatments and these improvements continued up to the 20 treatment marker. Control subjects did not demonstrate these changes. Some of the patients had bilateral knee pain and hence there was a total of 30 patients with comlete data presenting 44 knee joints. The shortwave intervention was by means of an induction coil technique (equivalent to the drum/monode applicator that some of you will be more familiar with) using 20 minutes treatment at a 'mild warmth' level. Bilateral knee problems were treated with 2 separate interventions at each visit. Synovial sac thickness changes were recorded and then presented as a % change from baseline for each individual which helps to take account of differences between individuals (though there has been some recent criticism of this analysis method). Usual type analysis with a repeated measures ANOVA and Bonferroni correction. Both treatment groups showed a significant reduction in synovial thickness (compared with control) after 10 sessions. There was no significant difference between the treatment groups – i.e. the addition of NSAID's did not appear to add to the benefit. Complex set of results, but essentially the synovial thickness continued to decrease after 10 and 20 sessions, though after the 20 sessions, the changes were no longer significant. The reduction in pain index outcome followed a very similar pattern. I expect that this research will be criticised for several reasons – some of which may be entirely valid. Patients self selected their group allocation (interesting idea) and I expect that there is likely to be some criticism of the number of treatment sessions – 30 shortwave treatment – or even 10 for that matter – is unlikely to be available in many healthcare systems. Criticisms apart, it is an interesting paper and shows (possibly) that shortwave need not be considered a 'dead' treatment.

TENS for Hemiplegia . . . . . .

Over recent years, there have been several significant papers regarding the use of muscle stimulation as a means to assist in the management of shoulder problems in patients post stroke. In the past, it was a commonly held view that electrotherapy generally, and electrical stimulation in particular were not a good idea at all\in patients with CNS lesions. The evidence would support the use of NMES in some circumstances, and there are a few examples below of research papers to illustrate the potential benefit of this mode of intervention.

Several papers have evaluated the potential benefit os using NMES to limit / prevent / reduce shoulder subluxation and shoulder pain post stroke. It is estimated that painful shoulder or subluxed shoulder affects around 80% of stroke patients and there is evidence that electrical stimulation post stroke has a significantly beneficial effect, especially if applied early post stroke as a preventative measure rather than later as a treatment to 'restore normality'.

A nice paper – not new I appreciate, but still a good one is **Chantraine et al. (1999) Shoulder pain and dysfunction in hemiplegia: effects of functional electrical stimulation Arch Phys Med Rehabil 80(3): 328-31**. The aim of the work was to determine the influence of functional electrical stimulation (FES) on subluxation and shoulder pain in hemiplegic patients. It was a controlled study of 24 months' duration beginning in the first month after onset of stroke involving 120 hemiplegic patients with both subluxed and painful shoulders were followed for rehabilitation before and after discharge. All subjects received conventional rehabilitation based on the Bobath concept. In addition, patients were alternately assigned to a control group or to receive additional FES for 5 weeks on muscles surrounding their subluxed and painful shoulder. The main outcome measures were clinical examinations, including range of motion, pain assessment, and x-rays, were performed at the start of the study, between the second and fourth weeks after onset of stroke, and subsequently at 6, 12, and 24 months. The FES group showed significantly more improvement than the control group in both pain relief (80.7% vs. 55.1%, p<.01) and reduction of subluxation (78.9% vs. 58.6%, p<.05). Furthermore, recovery of arm motion appeared to be significantly improved in the FES group (77.1% vs. 60.3% in the control group, p<.01). The authors conclude that the FES program was significantly effective in reducing the severity of subluxation and pain and possibly may have facilitated recovery of the shoulder function in hemiplegic patients. For interest, the stimulation parameters and treatment regieme went like this : 1st Sequence : 90 minutes, rectangular biphasic current at 8Hz; 350usec pulse duration using 4 electrodes. The 2nd Sequence was similar except that it was for 30 minutes @ 40Hz and the third sequence was for 10 minutes @ 1Hz. A total of 130 min/day week 1. Increase time for sequences 2 and 3 (by 5 mins) in subsequent weeks. 5 week treatment programme.

A meta analysis [**Ada and Foongchomcheay (2002) Efficacy of electrical stimulation in preventing or reducing subluxation of the shoulder after stroke: a meta-analysis Aust J Physiother 48(4): 257-67**] also identifies some useful features of this therapeutic approach. The purpose was to examine the efficacy of surface electrical stimulation for the prevention or reduction of shoulder subluxation after stroke. A meta-analysis of all eligible randomised or quasi-randomised trials of electrical stimulation for the treatment of shoulder subluxation was carried out. Seven (four early and three late) trials met the inclusion criteria. When added to conventional therapy, electrical stimulation prevented on average 6.5mm of shoulder subluxation (weighted mean difference, 95% CI 4.4 to 8.6). Therefore, evidence supports the use of electrical stimulation early after stroke for the prevention of, but not late after stroke for the reduction of shoulder subluxation

A study from \a short while ago looked at quads function post stroke comparing a group who received electrical stimulation with one that did not [**Newsam and Baker (2004) Effect of an electric stimulation facilitation program on quadriceps motor unit recruitment after stroke Arch Phys Med Rehabil 85(12): 2040-5**]. The aim was to compare maximum voluntary isometric torque (MVIT) and motor unit recruitment of the quadriceps after an electric stimulation facilitation program in persons affected by cerebrovascular accident (CVA). The trial was of 3 weeks duration using a randomized controlled methodology with an electric stimulation facilitation program added to standard care. Twenty patients receiving rehabilitation for a first-time CVA, commencing the therapy just over a month (on average) post-CVA. Patients were randomly as-

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

signed to study and control groups. All patients received standard physical therapy care and in addition, the study group received an electric stimulation facilitation program during weight-bearing and ambulatory activities of the PT program. MVIT and motor unit recruitment measured by interpolated twitch testing were used as the main outcome measures. A 2 x 4 repeated-measures analysis of variance was performed on measurements at 4 intervals: pretest, 1 week, 2 weeks, and 3 weeks. MVIT increased by 77% in patients receiving electric stimulation, compared with a 31% increase for the control group. Motor unit recruitment increased from 35% to 53% for the study group, whereas the control group recorded no change in recruitment ability.
It was concluded that the electrical stimulation, incorporated as a component of the 'normal' rehabilitation programme significantly improved motor unit recruitment in persons after CVA. For those that are interested, it is suggested that you get access to the original paper as the intervention was fairly complex, but essentially involved the use of electrical stimulation to the quads during weight-bearing activities with a symmetric biphasic stimulation @ 35Hz - hand triggered by therapist, 5 days week for 3 weeks

Other recent papers along these lines include :

- Yan et al (2005) Functional elec`trical stimulation improves motor recovery of the lower extremity and walking ability of subjects with first acute stroke. Stroke 36: 80-85
- Aydin et al (2005) Transcutaneous electrical nerve stimulation versus Baclofen in spasticity : Clinical and electrophysiological comparison. Am J Phys Med Rehabil 84(8)584-592
- Miller et al (2005) The effects of transcutaneous electrical nerve stimulation on spasticity.\Physical Therapy Reviews 10: 201-208
- Wu et al (2006) Influence of electric somatosensory stimulation on paretic-hand function in chronic stroke Archives Phys Med and Rehabilitation 87;351-357
- Wang et al (2002) Effects of functional electric stimulation on upper limb motor function and shoulder range of motion in hemiplegic patients. Am J Phys Med Rehabil 81(4)283-290
- De Kroon et al (2004) Electrical stimulation of the upper limb in stroke. Am J Phys Med Rehabil 83(8); 892-600

There are many others and I have identified these as examples rather than an exhaustive collection on the subject – mainly because I have been getting several enquiries along these lines in recent months. Happy to post more in the newsletter, but appreciate that the majority of readers are more concerned with musculoskeletal type rehab and treatment rather than neuro rehab per se.

NSAID's and tissue repair . . . . . .

This topic seems to generate a deal of debate whenever it appears on the agenda – planned or not! There`are LOADS of papers out there on the topic, but here are a couple of fairly recent ones that you might find of interest. **Cohen et al (2006) Indomethacin and Celecoxib impair rotator cuff tendon-to-bone healing. Am J Sports Medicine 34(3);362-369**. This paper reports the outcome of an animal model rotator cuff experiment on the basis that the use of NSAID's post surgery is common and appears to have the potential to inhibit recovery / repair. 180 rats were 'recruited' divided into three equal groups – one getting celecoxib, one lot getting indomethacin and one group as controls. There were animals sacrificed at several points (2,4 and 8 weeks) and the outcomes included gross inspection, biomechanical testing, histology and microscopy evaluating collagen formation and maturity.

Both drug groups demonstrated significantly lower load to failure compared with the controls at all time frames. There was no significant difference between the two drug treated groups. There were also significant organisational changes in the scar/collagen production between drug groups and

the controls The collagen was increasingly more organised (with time) in the control group but not in the drug treated animals. It was concluded that both drugs significantly inhibited tendon to bone healing and therefore raises an interesting issue with regards the use of these drugs post operatively. Appreciate that this work was done in an animal model and results do not automatically transfer across the boundary, but worth considering at the very least.

Another paper along the same lines for your collection – another one in a rat model, but this one looking at fracture healing rates with COX-2 inhibitors (**Endo et al (2005) Cyclooxygenase-2 inhibitor delays fracture healing in rats. Acta Orthopaedica 76(4); 470-474** * * be careful here – the journal changed its name last year I think * * .

The work (in brief) utilised a rat femoral shaft model with three experimental groups – one as a control, one getting the drug for 3 weeks and the other group for only week one. Using a radiographic scoring system and mechanical testing, it was shown that both drug groups fared less well than the control group, and raises the question with regards even short duration administration of COX-2 post fracture might not be such a smart plan.

Fracture Healing and Electrical Stimulation . . . . .

Lots of work going on with regards several forms of electrotherapy and fracture healing. Ultrasound, laser, pulsed shortwave and electrical stimulation amongst them. In answer to numerous queries, there are some of the electrical stimulation references below in case you want to chase any of them up. Most are review / summary type papers which is what I seem to get asked for in this context.

Aaron et al. (2004). Treatment of nonunions with electric and electromagnetic fields.
Clin Orthop(419): 21-9.

Anglen, J. (2003). The clinical use of bone stimulators.
J South Orthop Assoc 12(2): 46-54.

Childs, S. G. (2003). Stimulators of bone healing. Biologic and biomechanical.
Orthop Nurs 22(6): 421-8.

Evans et al. (2001). Electrical stimulation with bone and wound healing.
Clin Podiatr Med Surg 18(1): 79-95, vi.

Park and Silva (2004). Neuromuscular electrical stimulation enhances fracture healing: results of an animal model.
J Orthop Res 22(2): 382-7.

Shortwave . . . and metal in the tissue . . . ???

It is a widely held view that shortwave type therapies are contraindicated when there is metal in the tissue, and pulsed shortwave is considered OK so long as one is delivering energy below the thermal boundary. A recent paper by Draper (**Draper et al (2004) Low watt pulsed shortwave diathermy and metal plate fixation of the elbow. Athletic Therapy Today September 2004 ; 28-32**) relates a case study of a patient with significant elbow problems and for whom 'low dose' pulsed shortwave (48Watts) was used as an element of the treatment programme. The introductory sections of the paper also raise the issue behind the use of shortwave therapies for patients

with metal implants. The results of this particular case were positive and it raises several questions with regards the contraindication that is commonly listed. I hope to be able to do some collaborative work with Draper in the near future so that we can explore this relationship some more.

Another Shortwave one . . . . .

Shields has generated a long series of papers over the last 3-4 years concerning shortwave, pulsed shortwave, contraindications and therapist safety. In a recent paper (**Shields et al (2005) Physiotherpist's perception of risk from electromagnetic fields. Advances in Physiotherapy 7:170-175**) she reports the results of a survey sent to physiotherapists working in hospital departments, seeking their views on perceived risk and risk management. Having achieved a 90% response rate – pretty impressive – she identifies that therapists appear to be aware of the risks associated with shortwave but believe that they manage these risks adequately. Shields concludes that although therapists realise that they have the means to protect themselves from the potential risks in the department, in reality they are complacent about the dangers involved. Makes for an interesting read . . . . . .

Last one for this issue . . . . . Ultrasound and Fracture Healing

As mentioned in previous editions, and on some popular pages on the electrotherapy.org web site, the use of ultrasound for fracture healing continues to generate some interesting evidence. A recent case report (**Fujishiro et al (2005) Treatment of a bone defect in the femoral shaft after osteomyelitis using low-intensity pulsed ultrasound. Eur J Orthop Surg Traumatol 15:244-246**) identifies what appears to be a very impressive result in a patient who sustained a femoral fracture in which there were complications and then a stasis of the healing response. The incorporation of US into the treatment programme appear to have made a real difference (though one can always argue against this in a single case study), resulting in complete consolidation three months later. Low Intensity Pulsed Ultrasound is being used increasingly for fracture, ligament, tendon and associated repair stimulation, so watch this space for the next set of results.

OK, that will do for this issue. Still a very significant pile of papers on the floor, all wanting to get into the newsletter, but there is a limit on how many I can get into an issue – partly a time issue and partly to do with the technical aspects of sending out thousands of newsletters over a certain size.

As ever, look forward to your comments, requests for material / topics to cover in the next one and any suggestions for papers that I appear to have missed.

electronews@electrotherapyonline.co.uk

Next one should be a couple of months away

All being well, this should have come directly to those that have signed up for the newsletter. I'll put a copy on the web site (www.electrotherapy.org) for others that might want a copy.

Regards

Tim