Student name:	**Kyle Wolfe**
Topic of Study:	**Use of Modalities for Immediate to Short-term Pain Relief**

First Author (Last, 1st Initial); Journal Vol/#/ Year (Put complete reference below)		Article Type	Research Purpose	Sample(s)/Variables			Intervention(s)--Rename Groups as needed			Dependent Variables or Outcome measure(s)	Pertinent Results/Findings	Comment on evidence and clinical usefulness or Applicability (relevance to your question and clinical practice)	Determine level or Study quality
		RCT, Systematic Review, etc.	"The purpose of this study is…."	Age, Gender,# etc.	Independent Variables	Sampling Type	Experimental	Control	Other/NA				
Dry Needling	Gattie, E; *JOSPT* 47(3), 2017	Systematic review with meta-analysis	Previous reviews of dry needling have mostly focused on a specific body part or dry needling techniques performed by many different types of professionals. The purpose of this review is to determine both short and long-term effectiveness of dry needling when performed a PT for musculoskeletal pain	Patients older than 18 years old. Mean age of samples ranged from 23 years old to 72 years old. Studies included examined neck pain (6 studies), post-op shoulder (1), chronic low back (1), total knee arthroplasty (1), chronic ankle instability (1), myofascial pain (2), and fibromyalgia (1). Total of 723 subjects across 13 studies	Dry needling	Dry needling had to be performed by a physical therapist.	Dry needling performed by a physical therapist	Dry Needling was compared to control sham dry needling (3 studies), other interventions (6), or a variety of comparisons (2).		Pain using visual analog scale (VAS) from 0-10, pain-pressure threshold (PPT), and functional outcomes	Compared to control or sham interventions, dry needling demonstrated a moderate effect with a standard mean difference of -0.7 for reduced pain and a moderate effect size with a standard mean difference of 0.8 for improve PPT in the immediate to 12-week period. Compared to other interventions, dry needling demonstrated a small effect size with a standard mean difference of -0.43 for reduced pain and a moderate effect size with a standard mean difference of 0.61 for improved PPT in the immediate to 12-week period. Compared to control, sham, or other interventions, dry needling demonstrated no difference to a small effect size for improved function in the immediate to 12-week period.	This review only looked at physical therapists, which made it more applicable to physical therapy practice, especially since variation exists in techniques used for physical therapy. The effects on pain and PPT are more applicable since they utilized a standard scale or measurement, while the functional outcome assessment was based on multiple measures and is harder to strictly extrapolate results. The variation in pain location makes the results less applicable to any one problem, but also might demonstrate the effectiveness of dry needling for a variety of musculoskeletal pain conditions.	AMSTAR Meta-Analysis Tool: 14/16
	Tekin, L; *Clin Rheumatol* 32, 2013	Randomized Control Trial	The purpose of the study is to assess the efficacy of dry needling in patients with myofascial pain syndrome (MPS).	39 patients with MPS between 24-65 years old and symptoms for more than 6 months. The dry needling group consisted of 17 females and 5 males with an average age of 42.9 ± 10.9 years and average symptom duration of 63.5 ± 50.7 months. The control group consisted of 14 females and 3 males with an average age of 42.0 ± 12.0 years and average symptom duration of 57.9 ± 48.3 months.	Active or Sham Dry needling	Subjects were recruited from a treatment center based on symptoms and duration of symptoms. Subjects were randomized into their treatment group and evaluators were blinded to the subject's treatment groups.	Dry needling was performed by a physician. A trigger point in the area of pain was found based on pain response with the patient in sitting. Trigger point distribution in both groups was along the posterior cervical, thoracic, and scapular areas. The intervention group utilized a method of insertion until a response is felt, then withdrawing the needle. Dry needling was performed over 6 sessions in 4 weeks. No exercise or other modalities were used and patients were instructed to not take non-prescribed pain medications.	Sham dry needling was performed with the same set-up as the dry needling intervention. Once a trigger point was said to be found, the sham needle was used that caused a pricking sensation but does not pierce the skin. The treatment protocol followed the same duration and frequency as the intervention group.		Pain was measured using a 10 cm VAS. Quality of life was assessed using the 36-Item Short Form Questionnaire (SF-36). Outcomes were assessed before the first treatment, after the first treatment, and after the last treatment session.	The dry needling group demonstrated a significantly lower VAS score compared to the sham group at the first post-intervention measure ($p=0.034$) and after the sixth intervention ($p<0.001$). The dry needling group showed a significant reduction in VAS score at all measurements. The sham needling group also demonstrated significantly lowered VAS scores in the 2nd and 3rd measurements compared to the 1st baseline measure, but not between the 2nd and 3rd measures. The dry needling group demonstrated a significant ($p<0.05$) increase in SF-36 scores from the 1st to the 3rd measurement. The dry needling intervention group also used significantly less paracetamol, a pain-killer, medication than the sham group at the time of the third measurement ($p<0.01$), where use was equal at the first measurement.	In this study, both groups demonstrated significant reductions in pain levels, but the dry needling group demonstrated statistically significant greater reductions when compared to the sham group. In addition, patients in the dry needling group also demonstrated improved quality of life and less painkiller medication use after six treatments. Due to the decreased pain levels in the sham group, there is likely some placebo contribution to the decreased pain response following dry needling. However, the greater pain reduction in the experimental group lends support to the efficacy of dry needling in reducing pain levels in the short-term more than placebo alone. This study was performed by a physician using a technique that was not described in depth, so it could differ from techniques performed by a physical therapist. In addition, as the physician was performing the intervention based on palpation of trigger points, it could differ where the intervention would be applied based on the clinician performing the task, as the palpation might not be reliable. Although much more support is needed before claiming efficacy in reducing painkiller use overall, this proposed benefit of dry needling is important in the context of harmful side effects and reducing medication reliance.	PEDro RCT scale: 9/11
	Stephens, S; *J Ath Train* 55(7), 2020	Randomized Control Trial	The purpose of the study is to investigate the proposed theory of cupping in improving local blood flow and investigate the effects of a single session of dry cupping therapy on immediate and short-term neck pain	32 adults, including 15 men and 17 women between 18-40 years old (mean age 22.5 ± 2.8 years).	Dry Cupping	Subjects volunteered for the study and were included if they had self-reported nonspecific neck pain of at least 30/100 mm on the VAS within the last 2 weeks. Participants were randomly assigned to one of the three groups	Single session of dry cupping therapy. Cupping was applied to an area of the posterior neck that was found to be sensitive based on palpation. Cups were applied, then 3 suction pumps were used to create a vacuum which remained attached for 8 min before being removed.	One control group that rested in the same position as the intervention groups and had measurements taken at the same time frame	One sham cupping group. Intervention was the same as the cupping group except a 0.4mm hole was placed in the cup to reduce the length of the vacuum to about 30 seconds after placement, but still create the feeling of suction on the patient.	Subjective pain intensity using VAS from 0-100mm during gradual overpressure by the researcher, pain-pressure threshold using a digital pressure algometer ranging from 0-136.1 kg, and subcutaneous hemodynamic measurements using a wireless near-infrared spectroscopy device to calculate local blood flow. Recorded at baseline, immediately post-intervention, and 24 hours post-intervention. Immediately after treatment, NIRS unit was applied for 10 min of continuous measurements, then pain intensity and PPT were measured.	Subjects in the dry cupping group had a statistically significant and clinically meaningful pain reduction of 13 mm on the VAS compared to the sham and control groups. The subjects in the dry cupping group also had statistically and clinically significant increased superficial and deep oxygenated hemoglobin and total hemoglobin levels immediately after treatment. Both VAS and local blood flow changes were significant immediately post-intervention but not 24-hours post-intervention compared to other groups or baseline.	The results of this study show that dry cupping does have immediate subjective pain and measurable physiologic changes related to blood flow, but these changes are short-duration and return close to baseline after 24-hours. The increased blood flow was noted for oxygenated hemoglobin but not deoxygenated hemoglobin, so specific oxygen-rich blood might be elevated in the local tissue after treatment. This could have implications for improved healing based on improved blood dynamics, but the short-duration of the effects seems to indicate the use is more for subjective pain relief and short-term improvements. Since only one treatment was utilized, it is not known if these effects would change with repeated trials.	PEDro RCT scale: 7/11

Cupping	Kim, S; *BMJ Open* 8(2), 2018	Systematic Review with Meta Analysis	To assess the effects of cupping on pain, function, and quality of life in patients with neck pain	A total of 18 papers were included in the review. 7 studied wet cupping and 11 studied dry cupping. Mean patient ages included in the study ranged from 21 years old to 54.5 years old.	Cupping	Articles chosen were RCT that examined non-traumatic, including whiplash or sport injuries, neck pain that was chronic or acute. RCT had to examine dry or wet cupping therapy to the neck and a comparison group. Studies had to include an objective measure of pain, disability, or quality of life	Dry (11 studies) or wet (7 studies) cupping	Five studies compared cupping to no treatment. Ten studies compared cupping to active control. Five studies compared cupping with an active control to active control alone.		Pain intensity was measured using VAS, McGill Pain Questionnaire, or Northwick Park Neck Pain Questionnaire. Disability was measured using the Neck Disability Index. Quality of life was measured using the SF-36 or the EuroQol-5 Dimension questionnaire.	Compared to no treatment, cupping demonstrated a significant reduction in pain with a mean difference of -2.42. Compared to active control, cupping demonstrated a significant reduction of pain with a MD of -0.89, but meta-analysis demonstrated a MD of -1.50 for dry cupping and -0.70 for wet cupping. Adding cupping therapy to an active control resulted in a significant reduction of pain with a MD of -0.87. Cupping also demonstrated significant reduction of disability compared to no treatment (MD = -4.34), but a nonsignificant reduction when compared to active control. Cupping also demonstrated conflicting results in quality of life, showing significant improvements in the mental but not physical components of the SF-36 when compared to no treatment, but significant improvements in physical but not mental components in the SF-36 when compared to active controls. Only mild side effects that lasted short time periods were reported, and some were related to wet cupping procedures or positioning.	This study demonstrated improvements in pain using cupping when compared to any of the control interventions or added into a treatment. This provides support for the use of cupping in treatment of neck pain, although the study did not provide any details on the length of symptom relief and follow-up periods varied among studies. In addition, this study examined dry and wet cupping therapies, but only dry cupping therapy is a treatment in the PT scope in the United States. On the other hand, when meta-analysis allowed for comparison of the two cupping methods, dry cupping resulted in a larger effect size for pain reduction than wet cupping. There is some conflicting evidence that cupping therapy may improve function or quality of life when added into treatment as well. Another potential barrier to implementation is this study included studies mainly from Germany and Asia, so cupping methods likely differ between countries, especially related to the history of wet cupping as a treatment method in Asian countries. Overall, this study supports the use of dry cupping as a safe and effective treatment for pain relief with other potential benefits in patients with either chronic or acute neck pain.	AMSTAR Meta-Analysis Tool: 13/16
Pain Education	Louw, A; *J Man Manip Ther.* 27(5), 2019	Single Group Cohort Study	If application of a short pain neuroscience education (PNE) intervention for adults with non-chronic low back pain can change pain, movement, or perceived function in a single session. This is a smaller sample, single-arm study to assess data on a smaller scale before progressing to a RCT to assess ability of PNE to reduce amount of patients with LBP progressing from acute to chronic	Subjects were aged 18-85 years old and had low back pain for less than 3 months. The sample included 80 patients with a mean age of 45.2 ± 15.5 years, and a mean duration of symptoms of 39.3 ± 30.3 days. The subject included 49 females and 31 males. 60 subjects in the sample were currently working and 58 subjects had a a previous experience of low back pain.	PNE	Subjects were recruited from orthopedic physical therapy residents at private practice and hospital outpatient departments.	The PNE intervention was a 15-minute one-on-one educational session with a clinician and subject. The clinical used prepared images, drawings, and metaphors to explain the pain systems of the body, sensitization of the nervous system, and the goal of therapeutic interventions to decrease sensitization or improve thresholds of pain.	No control group or comparison group was utilized in this study. This study was a single-arm pilot study.		Pain measured using a numeric pain rating scale (NPRS), lumbar flexion measured in distance from longest digit to the floor, and straight leg raise using an inclinometer. Outcomes were measured pre-intervention along with measures of pain catastrophizing, perceived disability, and other measures to assess baseline differences. After the PNE intervention, pain, trunk flexion, and SLR were re-assessed, and the patients completed a Global Rating of Change Scale (GROC) to assess their perceived outcome.	Following the PNE intervention, subjects demonstrated a statistically significant difference in back pain measured using the NPRS, with a mean difference of 0.79 ± 1.5 ($p<0.001$). Subjects also demonstrated a statistically significant difference in leg pain using the NPRS, with a mean difference of 0.56 ± 1.3 ($p<0.001$). The differences were statistically significant, but did not reach the minimal clinically important difference of 2.0. Post-intervention, the subjects demonstrated a statistically significant difference in trunk flexion of mean 4.7 ± 9.2 cm ($p<0.001$), which was greater than the minimal detectable change of 4.5 cm. Post-intervention, subjects demonstrated a statistically significant improvement in SLR of mean 2.5° ± 7.0° ($p=0.002$), which was less than the minimal detectable change of 5.7°. 57.5% of patients rated themselves "a tiny bit better" on the GROC, but only 16 (20%) subjects rated themselves better than the minimal detectable change of 3 points on the GROC.	This study has limitations of not having a control group or blinding of any of the researchers, as the same clinicians who administered the PNE intervention also assessed outcome measures. The intervention explored was very short duration, including only one 15-minute PNE session with no other interventions performed. While many of the outcomes were statistically significant, most did not reach the MCID or MDC in that measure. This study supports the potential of PNE in improving immediate pain or function in patients with non-chronic low back pain, but it also shows that PNE likely has more benefits as part of a comprehensive treatment plan as the intervention is short enough to be utilized with other interventions. In terms of treating pain, there were improvements, while not clinically important, in patient-reported pain following the short intervention, which is encouraging considering the short-duration of the intervention. Another limitation of the study is assessing follow-up at any longer duration from the intervention. While the intervention showed initial positive changes, it would be worth exploring if the changes are lasting beyond the initial session, or if they can improve the effect of other interventions on pain or function. The other potential benefit demonstrated in this study is that the PNE intervention utilized only education, and thus can be performed while other passive interventions, such as electrical stimulation or thermal interventions, are also performed.	STOKE Checklist for cohort studies: 19/22

Low-Level Laser Therapy and Ultrasound	Rubira, A; *Advances in Rheumatology* . 59(57), 2019	Randomized Control Trial	The purpose was to compare the short-term effects of pulsed low-level laser therapy (LLLT), pulsed ultrasound, and continuous ultrasound on pain and disability in adult women with chronic non-specific low back pain	Women between 18-40 years old who had low back pain for more than 4 months without medication use for pain. The sample consisted of 111 female subjects with a mean age of each group between 22.17 $\pm$ 4.68 years and 22.92 $\pm$ 4.60 years.	Therapeutic Modality	Patients were recruited from referrals to physiotherapy or during screening in community treatment centers. Subjects were randomly assigned into one of the three treatment groups or the control group.	The first experimental group utilized pulsed LLLT at average power of 0.04 W, peak power of 70 W, pulse duration of 60 ns, and pulsed emission of 9500 Hz for 75 seconds at each of 6 treatment points for 18 total J over 7 min and 30 sec. The pulsed ultrasound group utilized a 3 MHz frequency. The continuous ultrasound group utilized a frequency of 1 MHz Both ultrasound groups received the intensity of 1 W/cm^2 for 2 min at each of the same 6 treatment points as the LLLT group. The ultrasound utilized an output with an ERA of 3.5 cm^2 and mean power of 7 W. The intervention groups received three treatments per week for 4 weeks until they had 10 total sessions.	The control group was awaiting treatment and received no intervention. The control group completed evaluation at the same time as the other intervention groups, then returned 4 weeks later for evaluation. Both the control and intervention groups were instructed to continue normal activity without use of analgesics, anti-inflammatories, muscle relaxants, or pain medication.		Dependent variables included pain, measured using a 10-point VAS scale immediately prior to and 5 minutes after each treatment. A McGill pain questionnaire was used to record information on the pain experience. The Roland-Morris questionnaire was used to measure function.	All three treatment groups demonstrated significant improvements in pain using the VAS and McGill and function using the Roland-Morris compared to pre-treatment and control values ($p<0.001$). The LLLT group demonstrated a statistically significantly greater improvement in pain score reduction on the VAS compared the other treatment groups. The continuous ultrasound group demonstrated statistically significantly greater improvements in pain using VAS compared to the pulsed ultrasound group. The pulsed ultrasound group demonstrated greater reductions in disability compared to the other treatment groups, but not statistically significant. The median change in VAS score for each group was 4.8 (25-75%: 1.3) for the LLLT, 3.7 (2.0) for the pulsed ultrasound, 3.7 (2.0) for the continuous ultrasound, and -0.2 (1.7) for the control group.	This study has limitations of only utilizing female participants, only reporting data prior to the first treatment and following the 10th treatment despite recording VAS score before and after each treatment, and not bringing in the control group for a placebo treatment session. Since the control group only was recorded prior to the first session and four weeks later, there can be a potential confounding factor of positive placebo effect from coming into a clinic ten times and receiving a form of treatment. This study does demonstrate that each of the interventions has improvements compared to the control group, but the differences between groups was typically small and non-significant. In terms of clinical application, this study lends support to the use of any of the three modalities for pain relief in the short-term, up to four weeks, but does not differentiate potential benefits between the treatments. The authors concluded that the LLLT treatment provided significantly greater improvements in pain and the pulsed ultrasound group demonstrated significantly greater improvements in function than the other interventions, but caution should be used when generalizing beyond the specific parameters of the modalities utilized in this study. For example, the pulsed and continuous ultrasound groups utilized different frequencies, so the 1 MHz treatment in the continuous might reach greater tissue depth than the 3 MHz pulsed ultrasound treatment.	PEDro RCT Scale: 10/11
Low-Level Laser Therapy	Konstantinovic, L; *Pain Med*, 11(8), 2010	Randomized Control Trial	The purpose was to examine effects of low-level laser therapy (LLLT) on pain or function in patients with neck pain with radiculopathy	60 patients with acute neck pain and unilateral radiculopathy for less than 4 weeks were included. Radiculopathy was confirmed via MRI and EMG to assess for acute neurological or musculoskeletal damage and rule out chronic or other conditions. The mean age in the treatment group was 41.71 $\pm$ 8.63 years and the mean age in the control group was 38.55 $\pm$ 7.86 years. The sample included 25 male participants and 35 female participants	Active or inactive laser therapy	Patients were recruited from a rehabilitation clinic at a university. Patients were randomly assigned to one of two groups using sealed envelopes that were concealed from the statistician. Both the patient and therapist were blinded to which unit was active or inactive.	The treatment group received 5 treatments per week for 3 weeks for 15 total treatments. The LLLT treatment consisted of a laser or 905 nm wavelength, 5,000 Hz frequency, 12 mW/cm^2 power density, 2 J of energy for each point, and treated at 6 points for 12 J total per treatment session. The unit was held stationary in contact with skin for 2 min at each point. Patients were instructed to perform low aerobic activity outside of treatment sessions.	The control group utilized the same protocol of 15 total treatments over 3 weeks but using an inactive laser. The inactive unit was applied in the same manner, with 2 min at each of 6 points. The patients received the same instructions to perform low aerobic activity outside of treatment sessions.		Outcomes assessed included pain, neck range of motion, disability, and health-related quality of life. Pain was assessed using a 100 mm VAS that was broken into a VAS for neck pain and VAS for arm pain. Neck mobility included flexion assessed using mm from chin to sternum and extension assessed using mm from occipital tuberosity to spinous process of C7. Disability was assessed using the neck disability questionnaire (NDI). Health-related QoL was assessed using the short-form 12 (SF-12) health survey. Subjects were evaluated before and after the 3 weeks of treatment by independent evaluators who did not perform treatment or statistical analysis.	Both groups demonstrated statistically significant improvements in all outcomes from baseline to post-treatment, but the treatment group showed greater improvements in all outcomes except for neck pain ($p = 0.09$). The difference in improvements in arm pain ($d = 0.98$) and neck extension range of motion ($d = 1.09$) demonstrated a high effect size. After treatment, patients in the LLLT intervention group were more likely to have lower pain levels with an odds ratio of 5.8. The LLLT group did report 8 adverse events, including 6 reports of symptom worsening during the first 3 treatment sessions for less than 6 hours, 1 report of nausea, and 1 increase in blood pressure. No adverse events were reported in the control group.	This study did a good job controlling for other variables and assessing the effects of laser as a sole treatment in as isolated of a way as possible, and found that there were short-term improvements in motion and pain more with the use of laser therapy than with sham treatment. While the LLLT treatment did not reach statistical significance in comparison to the control for neck pain, disability, or QoL, there were greater improvements in these measures. The LLLT treatment did cause statistically significant improvements compared to the control in neck extension active range of motion and arm pain. Since a proposed mechanism of laser treatment is an anti-inflammatory effect, this study leads support for the use of LLLT to treat radicular symptoms in the neck. It should be noted that the LLLT was applied in one protocol, and there are many different units that utilize different wavelengths of light and intensities, so this might not be able to be generalized for all laser units. Since patients were in the acute phase of treatment, some of the benefits might have been due to normal tissue healing, but the use of the control group helps to compare against those benefits. Based on the results of this study, patients with acute neck pain and radicular symptoms can benefit from LLLT for short-term pain relief and motion improvements.	PEDro RCT Scale: 11/11

Transcutaneous Electrical Neurostimulation (TENS)	Buchmuller, A; *Euro Journal of Pain*, 16(5), 2012	Randomized Control Trial	The purpose was to evaluate the efficacy of both active and sham TENS in terms of functional disability, short and long-term pain relief, quality of life (QoL), and use of analgesics in patients with chronic low back pain	236 patients with chronic low back pain for more than 3 months, both with or without radicular symptoms. The sample included 88 male patients and 148 female patients. The average age of the sample was 53.1 ± 12.9 years old. The median time from symptom onset was 36.5 months.	Active or inactive TENS therapy.	Patients were recruited from pain centers in France. Patients were randomized into the active or control group based on a computer-generated random number sequence.	The active TENS therapy treatment consisted of a combination of conventional continuous TENS (80 Hz, 50-100 µs, intensity to onset of painless tingling or max 25 mA) and intermittent burst TENS (2 Hz, 100-400 µs, intensity to produce weak muscle twitch, every 3 seconds). The combination TENS treatment was self-performed by patients using a program that was built into a device. Patients were instructed to perform the treatment 4 times per day, for 1 hour each session, for 3 total months. For radicular pain, two electrodes were placed on the painful back area and two electrodes were placed along the trajectory of the radicular symptoms. For patients without radicular pain, two electrodes were placed on the area of low back pain.	The control group utilized the same device as the treatment group and was provided the same instructions for use, but the device did not administer any electrical current. Electrode placement and device usage was the same as the treatment group.		Outcomes assessed included pain using a 100 mm VAS, function using the RDQ, QoL using the Dallas questionnaire and SF-36, patient satisfaction, compliance with treatment, and pain medication usage. Pain was assessed on a weekly basis, functional status was assessed at 6 weeks and 3 months, and all other outcomes were assessed pre and post-3 months of treatments.	Pain improvement of 50% or more was seen in the TENS group with both radicular (33.8% of patients) and non-radicular symptoms (25%), which was statistically significantly more than the control group with radicular (15%, p=0.0148) and non-radicular symptoms (6.7%, p=0.0003). No difference was found in functional status, patient satisfaction, QoL, compliance with treatments, or medication usage. No difference in pre- to post-treatment outcomes were found for either treatment group for all treatments except pain ratings. More than half of patients reported satisfaction with the treatment, with 61.6% in the TENS group and 57.3% in the control group.	This study was able to evaluate TENS treatment compared to sham treatment on patients with medium to long-term low back pain using a rigorous, 4-hour per day treatment protocol. While many variables were assessed, only a difference in pain ratings was found. Many of the patients reported a increase of more than 50% in pain ratings, but this was after 12 weeks of daily TENS treatment using a device operated by the patient. In this case, the therapist taught the patient and set the program for the TENS device, but was not needed for administering the treatment. This study did seem to confirm that greatest indication for TENS use is pain-control, as it did not have a significant impact on the other outcome measures. In addition, the TENS protocol utilized in this study was a combination of two TENS methods. One method utilized the gate control theory of pain with continuous sensory but not motor activation, while the other method utilized intermittent burst treament that included weak motor activation. Based on this, there is no way to draw conclusions about which TENS protocol to use with this population for pain control if the therapist is not able to replicate this combination treatment method. This study did have the benefit of treating patients both with and without radicular symptoms and separating outcomes between the groups to provide another variable that could be assessed, although no differences were found between the two presentations and their repones to the treatment. Although not significantly different between the groups, the group with radicular pain did demonstrate greater improvements in pain, but this could be based on differences in natural healing patterns between radicular and non-radicular pain. Based on this study, TENS could be potentially useful in patients with chronic low back pain to improve pain ratings, although it would require the patient to have their own unit and utilize the treatment consistently.	PEDro RCT Scale: 9/11
	Vance, CGT; *Phys Ther,* 92(7), 2012	Randomized Control Trial	The purpose of the study was to evaluate the efficacy of high and low frequency TENS for patients with knee osteoarthritis (OA) for pain and function.	75 patients with knee OA. Mean age of the sample ranged from 55 ± 14.4 to 57 ± 11.8 years old in the different groups. The total sample consisted of 46 female patients and 29 male patients. Average pain during screening eval ranged from 5.5 to 5.6 in the three groups on a 100 mm VAS. Average duration of knee pain in the three groups ranged from 83.5 ± 86.4 months to 121.6 ± 141.2 months. 56 of the patients used analgesic medications, but only 11 patients used opioid medications.	Type of TENS therapy.	Patients were recruited via flyers and screening from orthopedic and sports medine departments of a care center. Patients were randomized into one of three groups based on concealed allocation using sealed envelopes. Both subjects and examiners were blinded to which TENS type was provided.	The high-frequency TENS (HF-TENS) groups received TENS treatment using an asymmetrical biphasic waveform at frequency of 100 Hz, pulse duration of 100 msec, and intensity set to 10% below the motor threshold. The low-frequency (LF-TENS) groups received the same treatment, except the frequency was reduced to 4 Hz.. The treatment utilized 4 2"x2" electrodes to bracket the OA-affected knee. The patients received treatment starting 20 minutes prior to data collection and throughout testing, for 40-50 total minutes of treatment. The patients received one treatment session and outcomes were assessed prior to and after the single treatment. The intensity between groups was not statistically different with the mean intensity for each group as follows: 27.4 mA for HF-TENS, 24.1 mA for LF-TENS, and 24.5 mA for placebo TENS.	The control group utilized a placebo TENS unit that was identical in appearance to the experimental TENS unit. The placebo unit administered a current at the same 100 Hz frequency as the HF-TENS group, but the current was only delivered for the first 30 seconds and then ramped down over 15 seconds. For the remainder of the treatment time, which was identical to the experimental groups. Neither the TENS allocation examiner or data collection examiner could differentiate between the active and placebo TENS units when on. All instructions were consistent between groups.		Outcomes assessed included pain intensity using a 100 mm VAS, pain sensitivity using cutaneous mechanical pain threshold, pressure pain threshold (PPT), heat pain threshold, and heat temporal summation, and function using a timed up and go (TUG) test. Outcomes were assessed prior to the first treament, then re-assessed following 20 minutes of TENS application, although TENS treatment continued through the reassessment. One examiner measured outcomes while a different examiner administered the TENS application.	Pain at rest decreased significantly for all three groups (p=0.0001) from pre to post-treatment. PPT was significantly increased at 2 (affected knee, tibialis anterior) of the 6 assessed sites for the HF-TENS group (p=0.002, 0.0001) and at 1 site (affected knee) for the LF-TENS group (p=0.05), while the control group did not have any significant improvements in PPT. No changes were found for all other pain sensitivity outcomes. While time to complete the TUG did not change in any of the three groups, pain during the TUG increased significantly for all three groups (p<0.05).	This study showed support for the use of TENS as an effective immediate short-term pain relief, but this could be due to placebo effect, as the placebo TENS group saw similar improvements in subjective pain rating. While the placebo group did see improvements in pain intensity during rest and with activity, only the active TENS treatment groups saw improvements in PPT at the affected knee, which could suggest changes in nociceptive activity within the tissue. Through this method, this treatment could be effective in reducing sensitivity over areas of heightened pain responses; however, since this was only assessed in patients with knee OA, it cannot be generalized to patients with acute conditions or with hyperalgesia from central sensitization changes. In addition, this study examined immediate effect of a single session of TENS, which provides support for the use of TENS to immediately reduce pain during rest of activity in patients who have existing or chronic pain, but this study does not provide support on if differences exist in outcomes if the treatment was applied consistently over a period of time. As many therapists utilize TENS therapy to reduce pain during or following treatment sessions, it could be useful in these situations to allow the patient to tolerate treatment or evaluations with less subjective pain. In addition, activity was assesses using the TUG, which is a relatively low-intensity and short-duration activity, so it would be important to determine if the reduced pain effects also are found with more demanding or longer-duration activities. Based on this study, TENS appears to be useful for immediate reduction in pain rating and sensitivity around areas of pain, although part of this pain-relieving mechanism might be caused by placebo effect and the duration of benefits is not known.	PEDro RCT Scale: 10/11

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