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Case study

Treatment

The use of an app to manage carpal tunnel syndrome

MD Grant[1*]

Abstract

Introduction

Mobile technology is one of the fastest growing areas of disease management. This case describes the use of a mobile phone app to overcome pain and disability associated with Carpal Tunnel Syndrome (CTS).

Case Study

Based on EMDR the app uses bilateral stimulation to change the physical and emotional dimensions of the problem. Pain, disability, and depression were measured using the Short Form McGill Pain Questionnaire, The Pain Disability Index, The Pain Self-Efficacy Questionnaire and the Beck Depression Inventory. After three months of using the app the user reported a significant reduction in pain (90%), medication usage (100%), and disability (75%), and increased confidence in her ability to control her pain (300%). These gains were maintained and even improved upon at 6 months. Surgery which had been recommended by her treating medical specialist was no longer considered necessary.

Conclusion

This case suggests that apps may have a role to play in the management of CTS and other chronic pain conditions.

Introduction

With an estimated 40,000 health apps, including 24,000 medical apps, mobile phone applications ('apps') are one of the fastest growing adjuncts to the management of physical and mental illness[1]. A recent review found more than 6000 apps designed to address some of the most common chronic conditions[2]. There are apps to help track chronic pain, apps reminding people to take medications, apps to distract them from thoughts of self-harm and apps delivering cognitive behavioural therapy. Health experts are increasingly excited about the potential of apps. A recent article in the Clinical updates section of the IASP newsletter concluded that 'mobile technologies offer significant opportunities to improve access to health care, contain costs and improve clinical outcomes[3].

The popularity of health apps is generally thought to be based on a number of factors including convenience (most users take their smart-phone with them wherever they go), confidentiality and low cost. The average cost of an app is $1.47[4].

Apps may be used as an adjunct to treatment or as an alternative to treatment. For people who are already in treatment apps can be a useful adjunct for coping with the 'white spaces' in between appointments[5]. For the many people with mental health problems who never seek professional help, apps may offer a softer 'first-step' toward seeking professional help[6].

Despite their popularity, there is very little research regarding apps. A recent review by the IASP cited four research studies regarding the use of apps to manage chronic pain. One study found that adolescents who were given an app to help manage their sickle cell disease found it helpful in terms of improved coping and functioning[7]. Another study found that use of an app was more efficient than using pen and paper for tracking pain[8].

Despite these positive outcomes, concerns have been raised that this lack of research may have adverse consequences for users of health apps. Rosser & Eccleston have cautioned that the lack of research regarding apps poses a risk that "desperate individuals" may be misled[9]. Given the feedback pages that accompany most apps, this might not be as big a risk as has been suggested. Moreover, clinical research does not guarantee a completely unbiased view[10].

Nevertheless, as Vardeh et al. note, health professionals do need 'rigorous interventional studies' to evaluate the benefits of mobile technology[11].

The current case report describes the use of an app to alleviate pain, disability and distress associated with Carpal Tunnel Syndrome (CTS) and arthritis pain. CTS is thought to be caused by activity which involves repetitive wrist motion, holding the wrist in awkward positions for sustained periods of time, forceful pinching or gripping and work-related stresses[12].

Because untreated CTS may resolve or significantly improve in up to 49% of cases[13] conservative treatment is recommended initially[14]. Once CTS has become severe (as indicated by diminishing sensation, wasting of the thenar muscles, symptoms unchanged > 3 months) surgery is recommended. Surgery is generally effective and without it the prognosis is poorer[15].

Anxiety Release with bilateral stimulation' was primarily designed to help in the management of anxiety. Anxiety is the most common mental health problem in the world with a lifetime prevalence rate of 15%, and generally more common in the developed world[16].

In addition to anxious feelings, anxiety involves significant physiological distress including muscle tension, hypervigilance, heart palpitations, headaches etc[17]. Anxiety is also often associated with other conditions such as depression, PTSD, and chronic pain[18,19]. Sufferers of acute CTS have also been found to have significantly higher rates of anxiety, both current and lifetime, than other chronic pain sufferers[20].

The aim of this study was to evaluate the potential for an Anxiety app which incorporates sensory stimulation, to

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alleviate physical and emotional distress association with chronic pain.

Case Study

Most apps are based on existing treatments such as Cognitive Behavioural Therapy (CBT), Acceptance and Commitment Therapy (ACT), mindfulness meditation etc. 'Anxiety Release' is based on Eye Movement Desensitization and Reprocessing therapy (EMDR), an 8-stage trauma therapy centred around a focused attention/exposure bilateral stimulation process[21].

Bilateral stimulation can consist of left-right alternating visual, auditory or tactile stimuli. In therapy, bilateral stimulation involves instructing clients to focus on a distressing memory, including associated negative sensations, feelings and thoughts, followed by the bilateral stimulation and then an instruction to, "let whatever happens happen." This procedure is preceded by specified therapeutic assessment and preparation to protect clients who may be vulnerable to abreaction or other untoward reactions (eg; sufferers of complex PTSD, epilepsy etc). In the treatment of PTSD, and a growing number of other disorders, this process has been found to result in a lessening of distress and reintegration of traumatic material[22,23].

EMDR is thought to work by stimulating changes in the way negative memories are stored, as described in the Accelerated Information Processing Model[24].

EMDR defies understanding in terms of traditional models of psychotherapeutic processes. This has led to an emphasis on incorporating brain processes associated with sensory processing, memory and attention in the explanatory model[25].

For example, the dual task of remembering and focusing on the bls is thought to tax working memory in a way that weakens the painful memory[26]. Bls also triggers physiological effects (eg; decreased physiological arousal, decreased heart rate) which are thought to be responsible for the alterations in traumatic memories[27] and pain[28,29].

Although initial questions were raised regarding the contribution of bilateral stimulation[30] a recent meta-analysis found that bilateral stimulation does contribute significantly to the efficacy of EMDR[31]. Based on its ability to reduce physiological distress associated with PTSD and pain, and research demonstrating its efficacy in managing pain[32], it was felt that bilateral stimulation could be incorporated into mobile technology to help sufferers of anxiety and other forms of pain. Unlike most chronic pain apps which focus on education, coping and tracking the pain, Anxiety Release was primarily designed to alleviate the sensory-emotional aspects of the problem.

'Anxiety Release' consists of five sessions, incorporating education, sensory alteration and emotional containment (totalling 60 minutes of audio time). The first ('brain training') session provides some brief information about the role of the brain in anxiety, particularly focused attention vs open attention. Focused attention is thought to be a primary aspect of how EMDR therapy works[33] and it is increasingly viewed as an important element of treatment in the management of emotional distress[34].

The next two sessions of the app invite the user to focus on a selected anxious feeling or situation, followed by attending to visual and auditory bilateral stimulation in the form of coordinated lights and clicks and then to just 'let whatever happens happen.' A majority of emotionally distressed people find that this combination of stimuli leads to an attentional shift away from the negative feelings followed by a relaxation response[35]. It was hoped that the app would generate decreased sensory-emotional distress similar to that reported following EMDR although without the resolution and integration afforded by the full treatment approach.

The fourth session consists of 16 minutes of unguided visual and auditory bilateral stimulation. This session was designed to be used for undirected self-soothing and tends to be popular with users once they have become familiar with the process.

The fifth session consists of a guided 'safe-place' exercise designed as an emotional 'container' for users who feel overwhelmed by their anxiety or pain Lack of safety, whether from uncontrollable anxiety or other external threats, is recognized a core treatment need in PTSD, anxiety and pain[36,37,38].

Anecdotal evidence suggests that sufferers of complex trauma or Dissociative Identity Disorder can experience a worsening in their anxiety if exposed to bls without the help of a therapist trained in the use of specialized EMDR protocols[39].

Consideration was given to the potential for adverse reactions following use of this app. It has to be noted that abreactions in therapy are usually triggered by focused exploration of sensitive issues, which the app does not attempt to do. Even if traumatic material was triggered through use of the app, the use has the option of switching it off. It also remains to be established, in terms of research, just how impactful isolated elements of a therapy can be when delivered separately, whether EMDR, CBT ACT, graduated exposure or some other approach.

However, to be prudent, the app includes a warning that persons with multiple trauma or unresolved easily triggered trauma should not use it without first consulting with their therapist.

Case history

Julie had suffered from pain at various sites in her body including her chest, her back, her shoulders arms and fingers for three months due to postural problems at work. Julie was diagnosed as suffering from severe CTS and Arthritis. Julie's doctor had told her that some of her pain was referred pain. Julie described her pain levels as "extremely high" and although she normally disliked taking medication, she had been visiting the pharmacist "daily" in order to obtain medication that could alleviate the pain. She had been prescribed Panedine Forte

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(Paracetamol and codeine phosphate), but she found that the effects of this only lasted 2-3 hours and the side effects (eg; concentration problems, drowsiness), outweighed the benefits. Having to rely on medication so much made her feel weak and out of control.

Julie was also having difficulty breathing because of the muscular pain in her back and chest. Julie had lost a lung five years ago in the course of a battle with cancer. Surgery had been recommended for both hands, but Julie was afraid of surgery and preferred to take a more conservative approach to treatment. This would normally involve modification of the workplace environment and work-related duties involving the affected limbs. Unfortunately Julie's ability to modify her work duties was limited by the amount of data entry that her job involved and her commitment to fulfil her role as an executive. Physical therapy had only aggravated the problem. Despite her ever-present pain and limited treatment options, Julie been able to continue working, but she was worried about how much longer she could continue.

Assessment

Julie worked in a demanding occupation as a mid-level executive in property management. Julie was the eldest of three children. She was raised in a loving environment although tragedy struck when her father died of a heart attack when she was 16. As the eldest girl she assumed a responsible role in the family and a developed a self-reliant orientation that would characterize her personality into adulthood. At the time of her injury Julie was happily married with two grown-up children. Other than the stress associated with her cancer diagnosis and surgery, she had never suffered from anxiety or depression.

Julie was recruited for this study as a result of a chance encounter in the corridor of the medical suites where the author leases his consulting rooms, and the observation that she had a splint on her right wrist. After obtaining the above history, including Julie's aversion to surgery and medication, it was suggested that the app might be helpful. Julie indicated that she was sceptical but also that she willing to try anything. After a brief (< 10 minutes) demonstration of the app, Julie noticed some improvement and readily agreed to try it out for three months. Julie was given no other instruction than to use the app whenever she experienced pain or distress that she wanted relief from. There was no contact between Julie and the author during this time.

Outcome Measures

Julie was given a range of self-report tests designed to evaluate her pain levels, disability, perceived ability control her pain and depression, prior to commencing use of the app and three months later.

The Short Form McGill Pain Questionnaire (SF-MPQ). The main component of the SF-MPQ consists of 15 descriptors (11 sensory; 4 affective) which are rated on an intensity scale as 0 = none, 1 = mild, 2 = moderate or 3 = severe. Three pain scores are derived from the sum of the intensity rank values of the words chosen for sensory, affective and total descriptors. The SF-MPQ also includes the Present Pain Intensity (PPI) index of the standard MPQ and a visual analogue scale (VAS). The SF-MPQ has been shown to be a reliable pain measure[40] and sufficiently sensitive to demonstrate differences due to treatment at statistical levels comparable to those obtained with the standard form of this questionnaire[41].

The Pain Disability Index (PDI). The PDI measures the impact of pain on one's ability to participate in essential life activities.

The areas measured include family and home responsibilities, recreation, social activity, occupation, sexual behaviour, self-care, and life-support activity (e.g., eating, sleeping, breathing, etc.). The higher the index, (0-70) the greater the pain-related disability will be[42].

The Pain Self-efficacy questionnaire (PSEQ). The PSEQ is a 10-item self-report inventory that assesses the strength and generality of a patient's self-efficacy beliefs and his or her confidence to accomplish a range of activities despite chronic pain. Each item is scored on a 7-point Likert scale (ranging from 0 = "not at all confident" to 6 = "completely confident"), with a higher total score indicating stronger self-efficacy beliefs. The maximum possible score is 60[43].

The Beck Depression Inventory, 2 (BDI-II). The BDI-II assesses the intensity of depressive symptoms, responses are summed to give a score range between 0 and 63. The cut-off score for depression is 20 (Borderline clinical depression). A score of 21-30 indicates Moderate depression. A score above 31 indicates severe depression[44]. The BDI-II is an update of the original BDI, which was altered to correspond to criteria from the Diagnostic & Statistical Manual of Mental Disorders IV. The BDI-2 is a validated, reliable test for depression[45].

Prior to commencing use of the app Julie's pain score on the SFMPQ was 33. Her score on the pain disability index was 50. Her score on the pain self-efficacy questionnaire was 14. Her score on the Beck Depression Inventory was 15.

Results

After three months of using the app, and no additional medical or psychological interventions, Julie indicated she was experiencing significantly less pain and disability, significantly increased ability to control her pain and no symptoms of depression. As shown in figure 1, Julie's scores on the SFMPQ had decreased by 90% (from 33 to 3), pain disability by 75% (from 50 to 15) and depression by 100% (from 15 to 0). Her scores on the pain self-efficacy questionnaire had increased by 300% (from 14 to 55).

Julie added that she had only used medication twice since she started using the app and not at all in the last six weeks (compared with daily prior to the app). She also reported that the quality of her pain had changed, from a painful throbbing to a dull ache, and that she was more able to engage in physical pursuits such as gardening since using the app. Julie added that she was sleeping better and that she felt

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more relaxed in general. Julie stated that she mainly used the app when she felt pain (eg; after typing or gardening) rather than at a particular time. Julie estimated that length of time she listened to the app on individual occasions varied from two to ten minutes. Julie also reported that she found the bilateral stimulation particularly helpful, "it seems to clear my mind of anxious thoughts and makes me feel calm," she said. Julie also indicated that her need for surgery had been postponed, and that it was possible that she would no longer need it.

A 3-month follow-up indicated that the gains Julie had made had been maintained and even improved upon in terms of decreased pain, distress and disability. Julie reported that she had ceased all medication and surgery was no longer considered necessary. She had not used the app at all in the preceding months because she had not felt the need to. Julie admitted she had been prescribed Prednisone in the follow-up period (for an episode of pneumonia) and she felt this had helped eliminate the residual pain she had reported at her initial review.

The magnitude of the change for pain, disability, efficacy and depression was significant as measured by Jacobsons' Reliability Change Index (RCI), ie: pain; 11.31, disability; 14.76, efficacy; 16.85 and depression; 5.37. The RCI calculates the standard error of change in a single subject using the reliability coefficient and the standard deviation to produce a value regarding the likelihood that pre and post-test change is due to statistical error or treatment[46,47]. Any change greater than the RCI can be regarded as reliable.

Julie attributed her recovery to a combination of factors including the app, learning to pace herself better, the prednisone medication and generally managing her health better. In terms of her experience with the app Julie indicated that she liked its convenience, ("I am so time-poor") effectiveness, ("it works, it really works"), and the alternative to medication and surgery it represented. She also liked the fact that it gave her control over her condition.

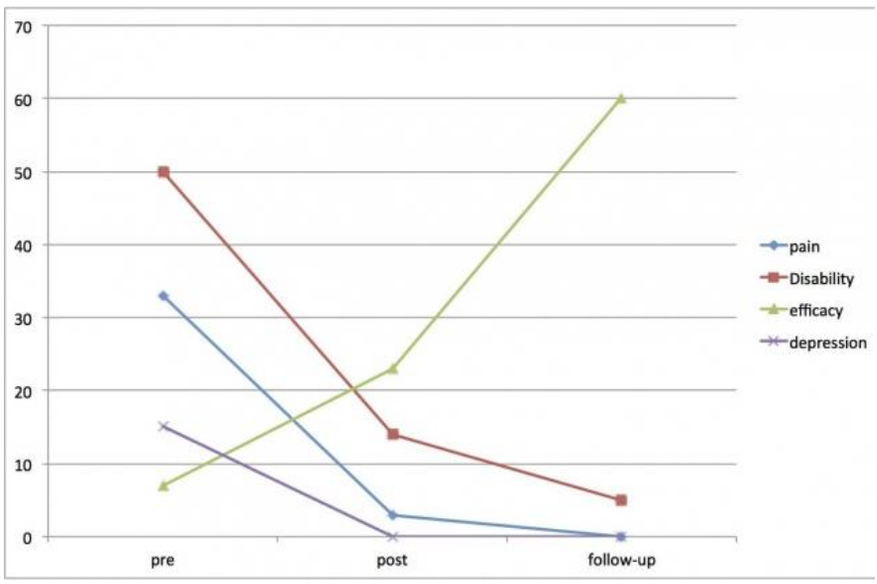

Figure 1: Changes in pain and disability following use of anxiety release app.

Discussion

This case demonstrates that an app can be a helpful adjunct to traditional treatments for CTS. In this case the app appears to have facilitated a significant reduction in the patient's levels of pain, disability, reliance on medication and need for surgery. While correlation is not causality, the almost immediate onset of these changes, following commencement of use of the app, at a time when the condition was well-established and not responding to treatment, coupled with the results of the RCI, strongly suggests they stem from Julie's use of the app. The nature and duration of the changes (eg; reduction of medication usage from daily to nil in the 6 weeks prior to initial review, and maintained at three months follow-up) suggests that these benefits are stable.

A notable aspect of this case is that the app which Julie found so helpful was designed for anxiety rather than pain. There are two possible explanations. One is that CTS is often associated with anxiety and the app may have indirectly influenced Julie's pain by reducing her emotional distress. Another is that the bls stimulated a direct reduction in the sensory dimension of Julie's pain. The latter would be consistent with the effects attributed to bls by other researchers and also matches with Julie's experience of the app. This would appear to be the first documented case of an app facilitating pain relief, an outcome which has been elusive for more comprehensive treatment programs.

Limitations in generalizing from this case include the fact that it is only one example and as such subject to the unique diagnostic and personality characteristics of the individual user. Apart from the trauma of her fathers premature death and her battle with cancer, Julie was free of the usual 'red flags" associated with chronic pain (eg; early developmental trauma, PTSD, depression, secondary gain factors, low socio-economic status etc). Julie was a highly motivated, emotionally stable, goal-oriented woman who achieved the changes documented here without any psychological input, other than a brief demonstration of the app. The duration of her pain (<12 months) was also at the lower end of the spectrum compared with many chronic pain sufferers.

Conclusion

This case report suggests that apps may offer a new and potent adjunct to other

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forms of pain management. The growth of mobile technologies seems likely to reinvigorate efforts to find alternative solutions to this challenging problem.

More research is certainly warranted. Two immediate areas for future research would be exploration of what kinds of interventions can most effectively be incorporated into apps and the suitability of different apps for different pain populations.

Consent

Written informed consent was obtained from the patient for publication of this case study and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

References

1. Chesarow N & Fogg BJ. Can health apps help patients change their behavior? Medscape News. 2013. Retrieved 29 September, 2013 from; http:www.medscape.com/viewarticle/806734.

2. Martinez-Perez B, de la Torre-Diez I, Lopez-Coronado M. Mobile applications for the most prevalent conditions in the World health Organization: review and analysis. Journal of Med Internet Research. 2013; 15(6):e20.

3. Vardeh D, Edwards R, Jamison RN & Eccleston C. There's an App for that: mobile technology is a new advantage in managing chronic pain. Pain: Clinical Updates. 2013, Dec. p1-7. Downloaded on 9th January 2013 from: www.iasp-pain.org/AM/AMTemplate.cfm?Section=Pain_Clinical_Updates1&Template=/CM/ContentDisplay.cfm&ContentFileID=3498.

4. 148 Apps. App store metrics. 2012. Retrieved 29 September 2013 from; http:148apps.biz/app-store-metrics/

5. Pomerance R. Have anxiety? Theres an app for that. US News Health and Wellness. 2012, Retrieved on 29 Sept. 2013 from; http:health.usnews.com/healthnews/healthwellness/articles/2013/05/02/have-anxiety-theres-an-app-for-that

6. Australian Bureau of Statistics. Mental Health. In; Australian Social Trends. 2009, (ABS catalogue number 4102.0), 13-18.

7. McClellan CB, Schatz JC, Puffer E, Schancez, CE, Stancil MT, Roberts CW. Use of handheld wireless technology for a home-based sickle cell pain management protocol. Journal of Pediatric Psychology. 2009, 34: 564-73.

8. Stinson JN, Jibb LA, Nguyen PC, Nathan PC, Maaloney AM, Dupuis LL, Gerstle JT, Alman B, Hopyan S, Strahlendorl C, Portwine C, Johnston DL, Orr M. Development and testing of a multi-dimensional iPhone pain assessment application for adolescents with cancer. Journal of Medical and Internet Research. 2013, 15:e51.

9. Rosser BA, Eccleston C. Smartphone applications for pain management. Journal of Telemedicine and Telecare. 2011, 17(6), 308-312.

10. Holmes J. All you need is cognitive behavior therapy? British Medical Journal. 2002, Vol. 324, 288-294.

11. Vardeh D, Edwards R, Jamison RN & Eccleston C. There's an App for that: mobile technology is a new advantage in managing chronic pain. Pain: Clinical Updates. 2013, Dec. p1-7. Downloaded on 9th January 2013 from: www.iasp-pain.org/AM/AMTemplate.cfm?Section=Pain_Clinical_Updates1&Template=/CM/ContentDisplay.cfm&ContentFileID=3498.

12. Reed P. Carpal Tunnel Syndrome. The Medical Disability Advisor, 5th Edition. The Reed Group. 2005, Downloaded on 9th January 2013 from;http:www.dlt.ri.gov/tdi/pdf/CarpalTunnel.pdf

13. Padua L, Padua R, Aprile I, Pasqualetti P, Tonali P. Italian CTS study group. Carpal tunnel syndrome. Multiperspective follow-up of untreated carpal tunnel syndrome: a multicenter study. Neurology. 2001, 56(11), 1459-1466.

14. British Society for Surgery of the Hand. Evidence for surgical treatment, Carpal Tunnel Syndrome (CTS). 2013, Retrieved 4 October, 2013 from; http:www.bssh.ac.uk/education/guidelines/carpal_tunnel_syndrome.pdf

15. Kitsis CK, Savvidou O, Alam A, Cherry RJ. Carpal Tunnel Syndrome despite negative neurophysiological studies. Acta Orthopaedica Belgica. 2002, 68 (2), 135-140.

16. World Health Organization. The Global Burden of Disease: 2004 Update. Geneva, Switzerland: WHO Press, 2008.

17. Henningsen P, Zimmerman T, Sattel H. Medically unexplained physical symptoms, anxiety and depression: A meta-analytic review. Psychosomatic Medicine. 2003, 65(4), 528-533.

18. Asmundsen GJ & Katz J. Understanding the co-occurrence of anxiety disorders and chronic pain: state of the art. Depression and Anxiety. 2009, 26(10), 888-901.

19. Blair MJ, Robinson RL, Katon W, Kroenke K. Depression and pain comorbidity: a literature review. Archives of Internal Medicine. 2003, 163(20), 2433-2445.

20. Mathis LB, Gatchel RJ, Polatin PB, Boulas JJ, Kinney RK. Prevalence of psychopathology in carpal tunnel syndrome patients. Journal of Occupational Rehabilitation. 1994, 4(4), 199-210.

21. Shapiro F. Eye movement desensitization and reprocessing: Basic principles, protocols and procedures. The Guilford Press. 1995.

22. Söndergaard HP & Elofsson U. Psychophysiological studies of eye movement desensitization and reprocessing, Journal of EMDR Practice and Research. 2008, 2, 282-288.

23. Maxfield L, Melnyk WT & Hayman GCA. A working memory explanation for the effects of eye movements in EMDR. Journal of EMDR Practice and Research. 2008, 2, 247-261.

24. Shapiro F. Eye movement desensitization and reprocessing: Basic principles, protocols and procedures. P28-54. The Guilford Press. 1995.

25. Jefferies F & Davis P. What is the role of eye movement in Eye Movement Desensitization and Reprocessing (EMDR) of posttraumatic stress disorder (PTSD)? A review. Behavioural and Cognitive Psychotherapy. 2012, Available on CJO.

26. van den Hout MA, Englehard IM. How does EMDR work? Journal of Experimental Psychopathology. 2012, 3(5):724-738.

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All authors abide by the Association for Medical Ethics (AME) ethical rules of disclosure.

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27. Sack M, Lempa W, Steinmetz A, Lamprecht F, Hofmann A. Alterations in autonomic tone during trauma exposure using eye movement Desensitisation, Journal of Anxiety Disorders, 2008, 22, 1264–1271.
28. Grant M. Pain control with EMDR; treatment manual. 4th revised edition. 2012, p52. Mark Grant. Kew. Victoria, Australia.
29. Grant M. EMDR in the treatment of various pains. Journal of Clinical & Consulting Psychology. 2014, (in submission).
30. Davidson PR, Parker KC. Eye movement desensitization and reprocessing (EMDR): a meta-analysis. Journal of Consulting and Clinical Psychology, 2001, 69(2), 305-316.
31. Lee CW, Cuijper P. A meta-analysis of the contribution of eye movements in processing emotional memories. Journal of Behavior Therapy and Experimental Psychology. 2012.
32. Grant M. EMDR in the treatment of various pains. Journal of Clinical & Consulting Psychology. 2014 (in submission).
33. Shapiro F. EMDR treatment: overview and integration. In; Francine Shapiro (Ed.), EMDR as an integrative psychotherapy approach. (p28). American Psychological Association. Washington. 2002.
34. Feliu-Soler A, Pascual JC, Borras X, Portella MJ, Martin-Blanco A, Armario A, Alvarez E, Perez V, Soler J. Effects of Dialectical Behavior Therapy-Mindfulness Training on Emotional Reactivity in Borderline Personality Disorder: Preliminary Results. Clinical Psychology and Psychotherapy, 2013, Mar 14
35. Elofsson UO, von Scheele B, Theorell T & Sondergaard HP. Physiological correlates of eye movement desensitization and reprocessing. Journal of Anxiety Disorders. 2007,22, 622-634.
36. Australian Centre for Posttraumatic Mental health. Australian guidelines for the treatment of Acute Stress Disorder and Posttraumatic Stress Disorder. 2013, Retrieved 18 September 2013 from;http:www.nhmrc.gov.au/_files_nhmrc/publications/attachments/mh13.pdf
37. Shapiro F. Eye movement desensitization and reprocessing: Basic principles, protocols and procedures. 1995, P68-95. The Guilford Press.
38. Grant M. Pain control with EMDR; treatment manual. 4th revised edition. 2012, p75-81. Mark Grant. Kew. Victoria, Australia.
39. Psychcentral, (2008). Neurotalk. 'EMDR therapy and getting worse.' [Online form Comment]. Retrieved on 30th September 2013 from; http:neurotalk.psychcentral.com/thread58553.html
40. Grafton KV, Foster NE and Wright CC. Test-retest reliability of the Short-Form McGill Pain Questionnaire: assessment of intraclass correlation coefficients and limits of agreement in patients with osteoarthritis. Clinical Journal of Pain. 2005, 21(1), 73-82.
41. McGill R. The short form McGill Pain Questionnaire. Pain. 1987, 30(2),191-197.
42. Chibnall JT, Tait RC. The Pain Disability Index: Factor Structure and Normative Data. Arch Phys Med Rehabilitation. 1994, 75,1082-1086.
43. Nicholas M. Self efficacy and chronic pain. Paper presented at the annual conference of the british psychological society.St. Andrews. 1989.
44. Beck AT, Brown GK and Steer RA. Beck Depression Inventory-II (BDI-II). San Antonio, TX: The Psychological Corporation. 1996.
45. Arnau, Randolph C, Meagher MW, Norris MP, Bramson R. Psychometric Evaluation of the Beck Depression Inventory-II With Primary Care Medical patients. Health Psychology. 2009, 20(2), 112-119.
46. Jacobson NS, Follette WC & Revenstorf D. Psychotherapy outcome research: methods for reporting variability and evaluating clinical significance. Behavior Therapy. 1984, 15, 336-352.
47. Jacobson N, Roberts L, Berns S & McGlinchey J. Methods for defining and determining the clinical significance of treatment effects: Description, application and alternatives. Journal of Consulting and Clinical Psychology. 1999, 67, 300–307.

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