Springer
the language of science

Dear Author/Editor,

Here are the proofs of your chapter as well as the metadata sheets.

Metadata

- Please carefully proof read the metadata, above all the names and address.
- In case there were no abstracts for this book submitted with the manuscript, the first 10-15 lines of the first paragraph were taken. In case you want to replace these default abstracts, please submit new abstracts with your proof corrections.

Page proofs

- Please check the proofs and mark your corrections either by
  - entering your corrections online
    or
  - opening the PDF file in Adobe Acrobat and inserting your corrections using the tool "Comment and Markup"
    or
  - printing the file and marking corrections on hardcopy. Please mark all corrections in dark pen in the text and in the margin at least ¼” (6 mm) from the edge.
- You can upload your annotated PDF file or your corrected printout on our Proofing Website. In case you are not able to scan the printout , send us the corrected pages via fax.
- Please note that any changes at this stage are limited to typographical errors and serious errors of fact.
- If the figures were converted to black and white, please check that the quality of such figures is sufficient and that all references to color in any text discussing the figures is changed accordingly. If the quality of some figures is judged to be insufficient, please send an improved grayscale figure.

Metadata of the chapter that will be visualized online

Book Title		International Handbook of Occupational Therapy Interventions
Chapter Title		Pain Management: The Multidisciplinary Roessingh Back-School Rehabilitation Program and E-Health Interventions for Chronic Pain Sufferers
Copyright		Springer International Publishing Switzerland 2015
Corresponding Author	Prefix	Prof. Dr.
	Family name	**Vollenbroek-Hutten**
	Particle	
	Given name	**Miriam M. R.**
	Suffix	
	Division	
	Organization	
	Address	Roessingshbleekweg 33B, 7522 AH Enschede, The Netherlands
	Email	m.vollenbroek@rrd.nl
Author	Prefix	Prof. Dr. Ir.
	Family name	**Hermens**
	Particle	
	Given name	**Hermine J.**
	Suffix	
	Division	
	Organization	
	Address	Roessingshbleekweg 33B, 7522 AH Enschede, The Netherlands
Author	Prefix	
	Family name	**Wever**
	Particle	
	Given name	**Daniel**
	Suffix	
	Division	
	Organization	
	Address	Roessingshbleekweg 33B, 7522 AH Enschede, The Netherlands
Abstract		Multidisciplinary team interventions aiming at breaking the vicious circle of impaired functioning are effective for clients with chronic pain. However, because of the growing number of people with such complaints, these interventions cannot be provided totally on a face-to-face basis. Therefore, the possibilities of intervention in the client's daily environment professionally supervised through distance learning, i.e., telemedicine, need to be considered.
Keywords		Chronic pain - Feedback - Monitoring - Multidisciplinary rehabilitation programs - Telemedicine

Chapter 47
Pain Management: The Multidisciplinary Roessingh Back-School Rehabilitation Program and E-Health Interventions for Chronic Pain Sufferers

Miriam M. R. Vollenbroek-Hutten, Hermine J. Hermens, and Daniel Wever

After a couple of sessions the client became aware of his inadequate thoughts concerning pain and his inadequate behavior as a consequence.

Abstract Multidisciplinary team interventions aiming at breaking the vicious circle of impaired functioning are effective for clients with chronic pain. However, because of the growing number of people with such complaints, these interventions cannot be provided totally on a face-to-face basis. Therefore, the possibilities of intervention in the client's daily environment professionally supervised through distance learning, i.e., telemedicine, need to be considered.

Keywords Chronic pain · Feedback · Monitoring · Multidisciplinary rehabilitation programs · Telemedicine

Introduction

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (IASP 2014). *Chronic pain* is a condition that has lasted longer than 6 or up to 12 months (Debono et al. 2013). It is a complex disorder, the development and maintenance of which is influenced by biopsychosocial factors (Gatchel et al. 2007; Gatchel 2013; Miles 2012[1]).

[1] References published after 2008 are added by the editor.

M. M. R. Vollenbroek-Hutten (✉) · H. J. Hermens · D. Wever
Roessingshbleekweg 33B, 7522 AH Enschede, The Netherlands
e-mail: m.vollenbroek@rrd.nl

I. Söderback (ed.), *International Handbook of Occupational Therapy Interventions,*
DOI 10.1007/978-3-319-08141-0_47

Epidemiology

Musculoskeletal disorders constitute a major problem in the European Union. The overall prevalence of muscular pain affected by work is 17%. The reported 12-month prevalence of problems in the neck and upper limbs is in the range of 30.5–39.7% in people living in the Netherlands. Absence from work of 2 weeks or more caused by musculoskeletal disorders is about 53%. The costs for musculoskeletal disorders are estimated in the European Union member states to be 0.5 and 2% of the gross national product. Moreover, pain complaints not related to work are a major and rapidly growing problem in Western industrialized countries. About 75 million Europeans (19%) complain of *chronic pain* (Breivik et al. 2006). These figures have increased during the past 6 years according to Leadley et al. (2012), who established that "general adult population reported an average chronic pain prevalence of 27% among European people."

Results

Varieties of multidisciplinary team interventions are available (see, for example, Michael et al. 2012). Among these, the interventions presented in this chapter are (1) the *Multidisciplinary Roessingh Back-school Rehabilitation Program* (*RRP*; Vollenbroek-Hutten et al. 2004) and (2) *the Myofeedback-based Tele-treatment service (MYOTEL*; e.g., Kosterink et al. 2010).

AQ1

Roessingh Back-School Rehabilitation Program

Purpose

The RRP focuses on improving clients' health status by reducing their level of pain and disabilities and increasing functional capacity.

Method

Candidates for Intervention

The RRP is aimed at clients with specific chronic pain, especially low back pain, who experience occupational performance deficits in their activities of daily living (ADL) and work performances. These clients have developed a decreased-ability condition, that is, a vicious circle of back pain, inactivity due to back pain and fear, restricted performance of physical activities, and decreased physical capacity (Mayer et al. 1985).

Inclusion criteria for the RRP are (1) ability to participate in daily activities for at least 3 days per week, (2) sufficient motivation, (3) ability to cooperate, and (4) trainability. Referral to the RRP follows a decision tree (van der Hulst et al. 2005; Vollenbroek-Hutten et al. 2004).

Setting

Clients with chronic low back pain are referred to the RRP program at a physical medicine and rehabilitation clinic by a general practitioner or specialist.

The Role of the Occupational Therapist

The occupational therapist (OT) is a member of the multidisciplinary rehabilitation team, which additionally consists of specialists in physical medicine and rehabilitation.

Rehabilitation team members perform assessments to screen clients suitable for RRP, goal setting, and evaluation. The OT and the physiotherapist conduct the interventions following the standard protocol on a weekly basis.

Clinical Application

The RRP

The program concerns interventions performed in client groups and focuses on the client's *self-management*. Clients need to learn to take responsibility for their situation and act on this when needed. Key elements in the intervention are *exercise, training, and education*.

The RRP is based on the Swedish back-school (Zachrisson-Forsell 1980) and multidimensional pain programs (Fordyce et al. 1985). These interventions assume that clients with chronic low back pain develop a deconditioning syndrome. The aim of the RRP intervention is to influence client's health and perceived disabilities positively in the following ways. The RRP interventions focus on teaching clients (1) to change behavior, especially thoughts that inhibit occupational performance; (2) self-management, such as taking responsibility for their own situation and acting on this in healthy ways; (3) ergonomically correct performance of physical activities, sports, and work; and (4) increasing and maintaining physical condition to facilitate performance.

Clients aspire to:

- Enhance clients' physical condition
- Learn how to obtain temporal adaptation balance their activity level with their capacity

- Get insight into the mechanism important for the development and maintenance of back pain
- Learn how to deal with pain and to take responsibility for their condition
- Get stimulus and advice on ADL independence
- Integrate to go back to and sustain in work
- Integrate in sports and leisure activities.

Clients are treated in groups of up to eight participants each week for 7 weeks. The intervention includes the following features:

- Two hours of conditioning training, the purpose of which is to break through the vicious circle of deconditioning and focus on:
- Strength training of leg, back, and abdomen muscles using fitness apparatus. The training starts with two series of ten movements at 60 % of maximum force, and is built up to three series of 20 movements at 70 % of maximum force.
- Cardiovascular (endurance) training on bicycle, rowing, or running ergometers. This training starts with 10 min at 65–80 % of VO_2 max, depending on the client's baseline condition, and is built up gradually by 2 min per week to 20 min at the end of the program. Each session of conditional training consists of warming up, training, and cooling down. Clients also learn how to improve their condition in their own time, and are encouraged to do so.
- Half an hour of sports. During these sessions, attention is paid to:
  - Basic principles and elementary forms of sports aimed at teaching clients how to perform these sports activities ergonomically correctly.
  - Enhancing clients' experience that sports activity is a pleasant way to maintain condition.
- Half an hour of swimming. Swimming is considered to have a positive effect on health, on the premise that people need various forms of movement. Besides, as muscle tone decreases, many clients experience a decrease in pain during swimming, permitting an increase in condition.
- One-and-a-half hours of *occupational therapy* to create awareness of clients' level of physical functioning and their physical capacity, with the aim of bringing these two into balance. For this purpose, activities focus on giving *insight into ergonomic principles,* and practicing these principles in activities such as wrapping and unwrapping a bookcase and wallpapering, with feedback on how these are being done, with the aim of *teaching clients to set their own effort limits*.
- Four hours of physiotherapy to build up the client's activity level; improve muscle function; acquire awareness of posture while standing, sitting, and walking; and train while running, jumping, pushing, pulling, carrying, and cycling, as well as in sports and game activities.

During the sessions, clients act, experience, and get feedback on appropriate ways of performing the program for further application at home.

Following this program, clients with work-related deficits due to back pain may be offered *individual occupational rehabilitation*.

Evidence-Based Practice

The effects of multidisciplinary back-school rehabilitation programs based on several systematic reviews and meta-analyses (van der Hulst et al. 2005) are good in some studies, but other studies report only moderate evidence of beneficial effects. For example, in a clinical trial, 30–50 % of clients showed an improvement in disability level. This result was nonsignificant when comparing the back-school participants with the "ordinary" rehabilitation participates (Vollenbroek-Hutten et al. 2004). On the other hand, a recent published study certifies the positive efficacy of back schools. For example, the study by Sadeghi-Abdollahi et al. (2012) on factory workers ($n=26$) showed significant improved pain relief after a 3-month period when estimated with the visual analogue scale (VAS) scale. However, the overall methodological quality of the studies reviewed is often poor. Thus, the efficacy of multidisciplinary interventions aimed for clients with chronic low back pain, based on back schools, is not yet clearly proven (van der Hulst et al. 2005).

AQ3

The Myofeedback-Based Tele-Treatment Service

Purpose

The MYOTEL focuses on improving clients' health status by reducing levels of pain and disability, increasing functional capacity, and improving work capacity.

Method

Candidates for the Intervention

The MYOTEL is intended for (1) clients with neck and shoulder disorders causing pain that restricts daily activities but still permits work and (2) nonworking clients with chronic neck–shoulder complaints who want to reduce their disabilities. *Exclusion criteria* are general pain syndromes such as fibromyalgia, excessive overweight (body mass index > 30), tumors, or severe deformities.

Setting

Referral to the MYOTEL program may be made by health professionals (general practitioner, neurologist, OT, physiotherapist, rehabilitation physician) or by clients themselves. The MYOTEL program is conducted in the client's home or workplace environment.

The Role of the OT

The OT explains the aim and content of the intervention to clients in a face-to-face visit and teaches them how to relax taut muscles. Thereafter, the OT has a weekly consultative role to discuss progress, goal setting, and evaluation, which is performed by connection via the Internet.

Results

Clinical Application

The provision of intervention in the client's home and work environment using ambulatory systems to monitor and provides feedback on inadequate behavior during everyday activities is exemplified by the MYOTEL services for feedback on muscle relaxation levels.

Theoretical Assumption

The MYOTEL is based on the assumption that clients with chronic pain have altered muscle activation patterns compared to asymptomatic controls (e.g., Nederhand et al. 2000). This is reflected especially in prolonged activation of muscles, that is, a decreased ability to relax after performing low dynamic, static, or mental tasks. The Cinderella hypothesis (Hägg 1991) states that low levels of taut muscle may contribute seriously to the development and maintenance of chronic pain. Based on these findings, the MYOTEL focuses on creating awareness of this absence of sufficient muscle rest.

Technical Application

The ReTra equipment (Fig. 47.1) is used to measure raw electromyography (EMG) data from the trapezius muscle. These data are converted into percentages of relaxation time. The clients get auditory and vibratory feedback when relaxation time is insufficient (Hermens and Hutten 2002).

The ReTra consists of (1) a harness with four incorporated surface electrodes that continuously measure surface electromyography (sEMG) from the trapezius muscle, (2) a portable unit that stores signals and processes functionality, and (3) a personal digital assistant (PDA) to provide continuous feedback to the client on the level of the taut muscle in the form of the EMG signals.

Client data are sent from the PDA (e.g., via GPRS) to a secure server. This is accessible to authorized health-care professionals via a web portal, and is thus available all the time regardless of where the OT is. The system enables the OT to interpret the data both in real time and historically, permitting e-consultation.

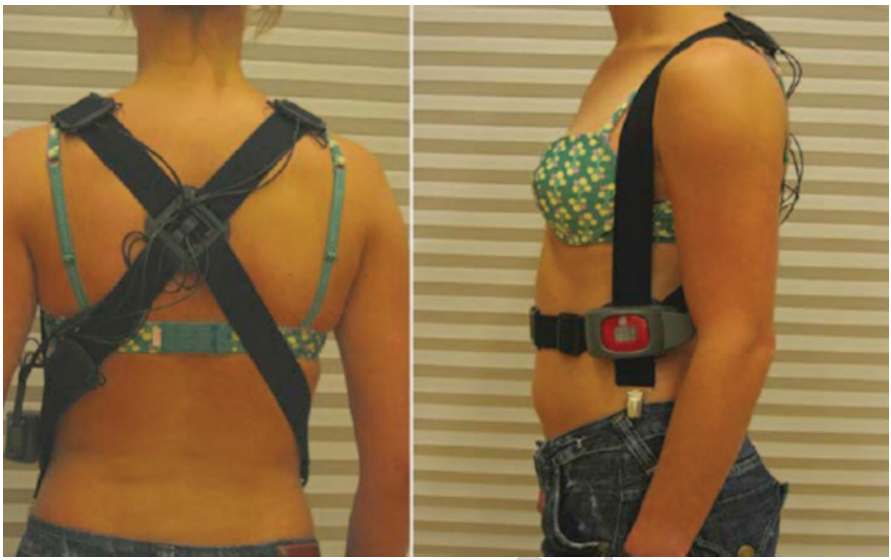

Fig. 47.1 The ReTra system worn by clients receiving the MYOTEL intervention. *Left*: Harness with incorporated dry surface electrodes. *Right*: Signal processing, storage, and vibration unit

The MYOTEL Intervention Program

As well as providing bio-data, clients keep a daily diary of their performed activities and the pain they experienced. At least once a week, but more often if needed, the OT and the client consult, face to face or by telephone.

Material for this consultation is the OT's study of the EMG data and the client's diary. The OT identifies the problems seen in muscle patterns (relaxation and activation). Based on these data, together with the diary activities, events when the client experiences low levels of relative rest times (RRT) are identified.

Subsequently, the OT and client together seek solutions, and the client is taught appropriate skills and techniques to develop better functioning.

The week's progress is discussed: how clients learn to identify aspects relevant to their pain, plus the very important aspect of learning self-management. The consultation ends with new tasks and an appointment for the next week.

Intervention normally ends after 4 weeks with a face-to-face visit. The MYOTEL program is presented in Fig. 47.2.

Evidence-Based Practice

Clients wear the harness with the surface electrodes (Fig. 47.1) during their performance of daily activities for 4 weeks. This gives very intensive and continuous *feedback* from tasks performed in their environment (Voerman et al. 2007a).

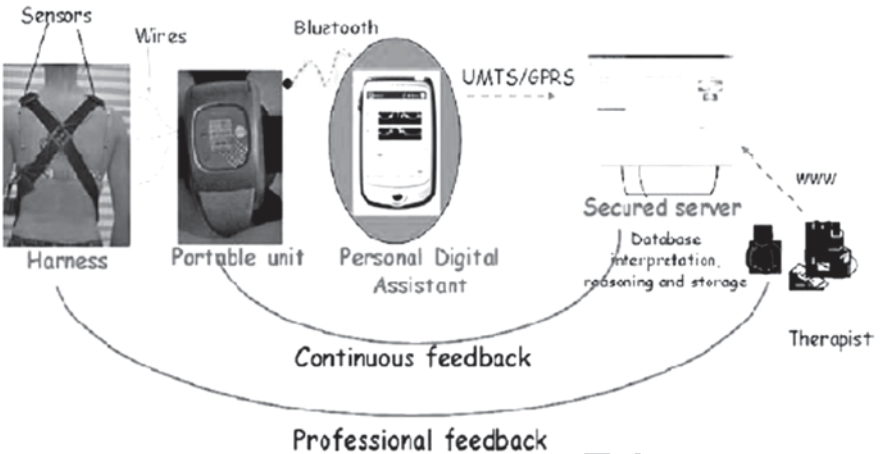

Fig. 47.2 Components, data transmission, and ways of feedback provision in the MYOTEL intervention. (http://www.utwente.nl/ewi/bss/research/research_themes/macro/myotel_project/)

The program enables quick adaptation of the client's behavior and shows the long-term effects of the intervention.

Hermens and Hutten (2002) investigated the processes underlying the feedback mechanisms andfound that changes in the discomfort factor were especially associated with changes in catastrophic thoughts; reduction in disabilities was related to decreased catastrophic thoughts about fear and avoidance of working. However, the percentage of explained variance was no more than 30–40 %.

The myofeedback intervention has been evaluated in a number of studies (Hermens and Hutten 2002; Huis in't Veld et al. 2008; Voerman et al. 2006, 2007b). The studies show that over the 4 weeks of the intervention, the clients wore the equipment for at least 4 h a day, 5 days per week. The results of a prognostic cohort study in 21 clients with work-related pain show that about 60 % improved their pain/discomfort scores directly after myofeedback, and these were practically unaltered at 4-week follow-up. A remarkable finding is that 35–40 % of the clients show a further improvement on pain/discomfort when the myofeedback had already ended (Hermens and Hutten 2002). A prognostic cohort study in 14 clients with chronic whiplash disorders showed significant effects on pain and disabilities: 55 % of the clients showed a clinically relevant reduction of pain and 36 % of disabilities (Voerman et al. 2006). In a randomized clinical trial comparing myofeedback ($n=41$) with ergonomic consultation ($n=38$) for clients with work-related neck–shoulder pain in the Netherlands and Sweden, 50 % of the clients experienced a clinically relevant reduction in pain and disability, which persisted at a 6-month follow-up (Voerman et al. 2007b). Myofeedback with remote data gathering and e-consultation is being tested in a cross-sectional study in 15 clients and 17 professionals to obtain insight into end users' attitudes and self-efficacy regarding remote myofeedback intervention. Results showed that both clients and professionals expect the remote myofeedback intervention to be feasible. Attitudes were positive in 66 % of the clients and 46 % of the professionals. In addition, the majority of clients and profes-

sionals considered their self-efficacy sufficient for remote myofeedback intervention, and they expected at least the same effects as from the traditional intervention (Huis in't Veld et al. 2007). A subsequent prognostic cohort study in ten women with work-related pain showed that RRP is technically feasible. Eighty percent of clients report;ed a reduction in pain intensity and disability directly after RRP (Huis in't Veld et al. 2008). The Swedish part of the European MYOTEL project (www.myotel.eu) was evaluated among 65 women with neck and shoulder pain. During three mounts, 33 women took part in the muscle relaxation training during their work performances. Evaluation showed no significant improvement in pain status among the "MYOTEL" women compared to those who participated in conventional care, however, with favors for comfort and time saving (Sandsjö et al. 2010[2]).

Discussion

The most common interventions aimed at chronic pain disorders are the multidisciplinary team approach, of which the RRP program as outlined as above is one. However, even with an indication tree for the decision on whether to intervene, the RRP is not effective for all clients. One explanation may be that not every client is inactive due to back pain and fear, and lowered physical capacity with, consequently, overloading. In Hasenbring et al. (2001), model and in clinical practice, some clients lack fear but ignore the pain. These clients are probably much more helped by learning how to balance their activity patterns during the day than by physical reconditioning. Here, the present intervention including goal setting may probably be more effective. Another explanation why the intervention does not suit all clients might be that the skills learned in the rehabilitation program are too specific, occasioning problems with their generalization to daily life. This led to the notion that providing intervention in the client's daily environment by using ambulant monitoring and feedback systems could be effective. The telemedicine concept manifested in the MYOTEL service seems to be a good example. Results of the first evaluations indicate that this service is at least as effective as traditional interventions. In clients with chronic back pain, such an intervention should focus on activity levels. An intervention with focus on temporal adaptation, in which the feedback is directed toward normalization of the disturbed activity pattern, might be effective.

References

Breivik H, Collett B, Ventafridda V et al (2006) Survey of chronic pain in Europe: prevalence, impact on daily life, and intervention. Eur J Pain 10(4):287–333

[2] No later scientific publications were found in the database PubMed.

Debono DJ, Hoeksema LJ, Hobbs RD (2013) Caring for patients with chronic pain: pearls and pitfalls. J Am Osteopath Assoc 113(8):620–627

Fordyce WE, Roberts AH, Sternbach RA (1985) The behavioral management of chronic pain: a response to critics. Pain 22:113–125

Gatchel RJ (2013) The biopsychological model of chronic pain. Future medicine: clinical insights. Chronic pain. doi:10.2217/ebo.13.469

Gatchel RJ, Yuan BP, Maldelon LP, Fuchs PN, Turk DC (2007) The biopsychosocial approach to chronic pain: scientific advances and future directions. Psychol Bull 133(4):581–624. http://www.futuremedicine.com/doi/abs/10.2217/ebo.13.469 Accessed 14 Feb 2014

Hägg GM (1991) Static workload and occupational myalgia—a new explanation model. In: Anderson P, Hobart D, Danoff J (eds) Electromyographical kinesiology. Elsevier, Amsterdam, pp 141–144

Hasenbring MI, Hallner AD, Klasen B (2001) Psychologische mechanismen im Prozess der Schmerzchronifizierung Unter- oder überbewertet? Schmerz 15:442–447

Hermens HJ, Hutten MMR (2002) Muscle activation in chronic pain: its intervention using a new approach of myofeedback. Ind J Ergon 30:325–336

Huis in't Veld MHA, Voerman GE, Hermens HJ et al (2007) The receptiveness toward N remotely supported myofeedback intervention. Telemed J E Health 13(3):293–301

Huis in't Veld RM, Huijgen BC, Schaake L, Hermens HJ, Vollenbroek-Hutten MM (2008) A staged approach evaluation of remotely supervised myo-feedback treatment (RSMT) in women with neck-shoulder pain due to computer work. Telemed J E Health 14(6):545–551

International Association for the Study of Pain (IASP) (2014) Taxonomy. http://www.iasp-pain.org/Education/Content.aspx?ItemNumber=1698&navItemNumber=576. Accessed 14 Feb 2014

Kosterink SM, Huis in't Veld RMHA, Cagnie B, Hasenbring M, Vollenbroek-Hutten M (2010) The clinical effectiveness of a myofeedback-based teletreatment service in patients with non-specific neck and shoulder pain: a randomized controlled trial. J Telemed Telecare 16(6):316–321. doi:10.1258/jtt.2010.006005

Leadley RM, Armstrong N, Lee YC, Allen A, Kleijnen J (2012) Chronic diseases in the European Union: the prevalence and health cost implications of chronic pain. J Pain Palliat Care Pharmacother 26(4):310–325. doi:10.3109/15360288.2012.736933

Mayer TG, Smith SS, Keeley J, Mooney V (1985) Quantification of lumbar function. Part 2: sagittal plane trunk strength in chronic low-back pain clients. Spine 10(8):765–772

Michael JL, Sullivan MJL, Mankovsky T (2012) Chronic pain, types of (cancer, musculoskeletal, pelvic), management of. In: Gellman MD, Turner JR (eds) Encyclopaedia of behavioral medicine. Springer, New York, pp 409–415

Miles E (2012) Biopsychosocial model. In: Gellman MD, Turner JR (eds) Encyclopaedia of behavioral medicine. Springer, New York, pp 227–228

Nederhand MJ, Ijzerman MJ, Hermens HJ et al (2000) Cervical muscle dysfunction in the chronic Whiplash Associated Disorder Grade II (WAD II). Spine 25(15):1938–1943

Sadeghi-Abdollahi B, Eshaghi A, Hosseini SN, Ghahremani M, Davatchi F (2012) The efficacy of back school on chronic low back pain of workers of a pharmaceutical company in a Tehran suburb. COPCORD stage II study. Int J Rheum Dis 15(2):144–153

Sandsjö L, Larsman P, Huis in 't Veld RM, Vollenbroek-Hutten MM (2010) Clinical evaluation of a myofeedback-based teletreatment service applied in the workplace: a randomized controlled trial. J Telemed Telecare 16(6):329–335

Van der Hulst M, Vollenbroek-Hutten MMR, Ijzerman MJ (2005) A systematic review of sociodemographic, physical and psychological predictors of (multidisciplinary or back school) intervention outcome for clients with chronic low back pain. Spine 30(7):813–825

Voerman GE, Vollenbroek MMR, Hermens HJ (2006) Changes in pain, disability, and muscle activation patterns in chronic whiplash clients after ambulant myofeedback training. Clin J Pain 22(7):656–663

Voerman GE, Sandsjö L, Vollenbroek-Hutten MMR et al (2007a) Changes in cognitive behavioral factors and muscle activation patterns after ambulant myofeedback training in work-related neck-shoulder complaints: relations with pain and disability. J Occup Rehabil 17(4):593–609

Voerman GE, Sandsjö L, Vollenbroek-Hutten MMR et al (2007b) Effects of ambulant myofeedback training and ergonomic counselling in female computer workers with work-related neck-shoulder complaints: a randomized controlled trial. J Occup Rehabil 17(1):137–152

Vollenbroek-Hutten MMR, Hermens HJ, Wever D et al (2004a) Main and subgroup specific effects of a multidisciplinary rehabilitation program for clients with chronic low back pain. Clin Rehabil 18(5):566–580

Vollenbroek-Hutten MMR, Hermens HJ, Wever D, Gorter M, Rinket J, Jzerman MJ. (2004b) Differences in outcome of a multid;isciplinary treatment between subgroups of chronic low back pain patients defined using two multiaxial assessment instruments: the multidimensional pain inventory and lumbar dynamometry. Clin Rehabil 18(5):566–579

Zachrisson-Forsell M (1980) The Swedish back school. Physiother 66:112–114

Chapter 47: Author Query

AQ1. Please specify whether the year 2004a or 2004b is valid for the citation “Vollenbroed-Hutten 2004.”

AQ2. Please specify whether the year 2004a or 2004b is valid for the citation “Vollenbroed-Hutten 2004.”

AQ3. “Sadeghi- Abdooli 2012” was changed to “Sadeghi- Abdollahi 2012” to match the reference list. Please confirm or correct the change.