BIOFEEDBACK

Soweit in diesem Kontext personenbezogene Bezeichnungen nur in weiblicher oder nur in männlicher Form angeführt sind, beziehen sie sich generell auf Frauen und Männer in gleicher Weise.

1 Inhaltsverzeichnis

2 Kurzbericht

Die Frage nach der Evidenz für Biofeedback erfordert starke Eingrenzung, da das Themenfeld umfassend und Biofeedback in verschiedenen Formen und bei verschiedenen Beeinträchtigungen eingesetzt wird. Es wurde daher ein erster genereller und sehr oberflächlicher Überblick über die Bereiche erstellt, auf die weitere Fragen eingegrenzt werden können.

288 Reviews zum Thema Biofeedback wurden auf Abstractebene gelesen und diejenigen in die Übersicht inkludiert, die im Abstract über den Einsatz von Biofeedback berichten.

Aufgrund der Studienlage wurden Kategorien für die Themen Schlaganfall, kardiovaskuläre Erkrankungen, Defäkationsstörungen, Schmerzen, neurologische und psychische Beeinträchtigungen und sonstige Störungen gebildet.

Für den Einsatz von Biofeedback in der Rehabilitation nach Schlaganfall besteht Uneinigkeit hinsichtlich der Wirkung zur Verbesserung von Bewegungsfunktionen.

Für den Einsatz bei der Behandlung verschiedener kardiovaskulärer Erkrankungen existieren sehr zurückhaltende Aussagen.

In der Behandlung von Defäkationsstörungen finden sich widersprüchliche Aussagen, generelle Kritik an der Methodik der inkludierten Studien, sowie die Erwähnung der psychischen Komponente für diese Behandlungsspezifität.

Für die Schmerzbehandlung gibt es generelle Empfehlung für den Einsatz von Biofeedback vor allem hinsichtlich der Umpolung des Schmerz-Lern-Gedächtnisses, wenngleich auch hier methodische Kritik anklingt und die Mitarbeit des Patienten als Voraussetzung thematisiert wird.

Für den Bereich neurologischer Behandlung, vorwiegend in der Epilepsiebehandlung, findet sich widersprüchliche Evidenz, qualitativ hochwertige Reviews (Cochrane) berichten wenig bis gar keine wissenschaftliche Beweisbarkeit.

In der psychisch-psychiatrischen Behandlung wird Biofeedback als Möglichkeit zur Selbstkontrolle des Patienten gesehen, hierbei wird der Glaubens- und Placeboeffekt thematisiert und als durchaus nutzbar erkannt, und zwar sowohl beim Patienten als auch beim Arzt.

Für verschiedene weitere Einsatzgebiete (Fibromyalgie, Kiefersperre, etc.) wird Biofeedback als „besser als Placebo“ beschrieben, mit positiven Tendenzen und keiner klaren Evidenzaussage.

Generell kann nach diesem ersten groben Überblick gesagt werden, dass Biofeedback sehr unterschiedlich eingesetzt wird und vor allem bei Beeinträchtigungen mit stark psychischer Komponente seinen Wirkungsbereich findet. Es scheint jedenfalls eine Möglichkeit darzustellen, Patienten zu unterstützen,

für deren Leiden keine andere gesicherte wirksame Therapie existiert und die dennoch nicht allein gelassen werden können.

Evidenz: Peer Group: Dr. Gottfried Endel, Dr. Irmgard Schiller-Frühwirth

Geurts 2005, Van Peppen 2004, Barcley Goddard 2004 (Cochrane), Stein 2004, Pollock 2003 (Cochrane), Chae 2003, Mauritz 2002, Chae 2000, Miller 1999, Nichols 1997, Schwickert 2006, Reyes del Paso 1999, Kranitz 2004, Linden 2006, Davis 2002, Galper 2003, Buselli 1999, Jorge 2003, Wald 2007, Stessman 2003, Heymen 2003, Sanmiguel 2003, Rao 2003, Schiller 2001, Brooks 2000, Wofford 2000, Nurko 2000, McGrath 2000, Chiarioni 2006, Remes-Troche 2006, Brazzelli 2001 (Cochrane), Rao 1998, Barlow 1997, Norton 2000 (Cochrane), Brazzelli 2006 (Cochrane), Chiarioni 2005, Tariq 2003, Hinninghofen 2003, Kroesen 2003, Rudolph 2002, Norton 2001, Norton 2001b, Soffer 2000, Norton 2006 (Cochrane), Hosker 2000 (Cochrane), Andrews 2005, Norton 2004, Bassotti 1997, Read 1999, Palsson 2004, Flor 2007, Flor 2003, Nielson 2001, Zermann 2001, Hershey 2006, Powers 2005, Biondi 2005, Lipchick 2002, Penzien 2002, Hermann 2002, Solomon 2002, Evers 2002, Diamond 1999, Van Hook 1998, Sandor 2005, Andrasik 2004, Niederberger 2004, Baumann 2002, Kropp 2002, McGrath 1999, Huntley 2004, Victor 2003, Haythornthwaite 2001, Rusy 2000, Myers 2007, Middaugh 2002, Anderson 2002, Weydert 2003, Rosenbaum 2005, Sterman 2006, Ramaratnam 2005, Sheth 2005, Walker 2005, Lubar 1998, Hammond 2005, Moore 2000, Basmajian 1999, Morin 1999, Moss 2002, Hirshberg 2005, Nash 2000, Holtmann 2006, Fox 2005, Loo 2005, Monastra 2005, Rojas 2005, Butnik 2005, Rossiter 2004, Doggett 2004, Brue 2002, Ramirez 2001, Mamtani 2002, Wickramasekera 1999, Cortoos 2006, Weiskopf 2004, Blakemore 2000, Lincoln 2006, Gur 2006, Holdcraft 2003, Hadhazy 2000, Offenbacher 2000, Berman 1999, Medlicott 2006, McNeely 2006, Crider 2005, Thatcher 2000, Thornton 2005, Platz 2003, Ritz 2004, Shenefelt 2003, Bilkis 1998, Meningaud 2006, Locatelli 2005, Nyland 2004, Manyam 1999, Maryn 2006, Karanidas 2006, Van Dijk 2004, Trudeau 2005

Autorin: Mag. Ingrid Wilbacher

Layout: Mag. Dagmar Bernardis

3 Fragestellung

Eine Recherche über die Evidenz von Biofeedback soll erstellt werden.

4 Begriffsdefinition

Mit dem englischen Begriff Biofeedback (dt. etwa *Biorückmeldung*) wird eine Methode aus der psychosomatischen Forschung und der Verhaltenstherapie bezeichnet, bei der Veränderungen von Zustandsgrößen biologischer Vorgänge, die der unmittelbaren Sinneswahrnehmung nicht zugänglich sind mit technischen (oft elektronischen) Hilfsmitteln beobachtbar d. h. dem eigenen Bewusstsein wahrnehmbar gemacht werden. Biofeedback wird häufig zur Entspannung, aber auch zur Rehabilitation (zum Beispiel von erlahmten Muskeln) eingesetzt.

Körpereigene Vorgänge, die der Homöostase dienen, sind dem Bewusstsein nicht direkt zugänglich, so dass bei Dysregulationen auch nicht bewusst auf den Regelkreis eingewirkt werden kann. Biofeedback dient dazu, mittels physiologischer Messungen eine Körperfunktion (wie zum Beispiel Puls, Hautleitwert oder Hirnströme) dem Bewusstsein zugänglich zu machen. Dies geschieht im allgemeinen durch Töne (Lautstärke, Tonhöhe oder Klangfarbe) oder Visualisierungen (Zeiger oder Balkengraphiken). Der Patient versucht durch diese Rückkopplung eine Verbesserung der Regulation durch operante Kontrolle zu erzielen[1].

5 Erstellung von eingegrenzten Fragen

Zum Thema Biofeedback wurden in Medline 288 Reviews gefunden.

Eine allgemeine Themenzuordnung ergab folgendes Bild:

Biofeedback und…	**Anzahl an Reviews**
Basiswissen	23
Kardiovaskuläre Erkrankungen	19
Defäkationsstörungen	45
Neurologische Erkrankungen	10
Schmerzen	42
Psychische Erkrankungen	46
Urologische Störungen	43
Andere	60
	288

Für Biofeedback bei Harn- und Stuhlinkontinenz existiert ein Bericht der EBM Abteilung aus dem Jahr 2005. Diese Themen werden daher in diesem Bericht ausgeklammert.

Es werden daher folgende PICO Fragen erstellt:

- Einsatz von Biofeedback versus Goldstandard bei Patienten mit kardiovaskulären Erkrankungen (nach Myokardinfarkt, nach Stroke, bei diabetischen Komplikationen) hinsichtlich Outcome Beweglichkeitsverbesserung, Gleichgewichtstraining
- Einsatz von Biofeedback versus Goldstandard bei Patienten mit Konstipation hinsichtlich Outcome Normalfunktion
- Einsatz von Biofeedback versus Goldstandard bei Patienten mit Schmerzerkrankungen (chronischer Schmerz, Kopfschmerz, Migräne, andere) hinsichtlich Outcome Schmerzsenkung
- Einsatz von Biofeedback versus Goldstandard bei Patienten mit neurologischen Erkrankungen (Epilepsie, andere) hinsichtlich Outcome Anfallsverringerung

- Einsatz von Biofeedback versus Goldstandard bei Patienten mit psychischen Erkrankungen (Aufmerksamkeitsdefizit-Hyperaktivitätssyndrom bei Kindern, Angststörungen, Schizophrenie, andere) hinsichtlich Outcome Symptombesserung
- Einsatz von Biofeedback versus Goldstandard bei Patienten mit einzelnen Krankheitsbildern (Tinnitus, Beckenbodenschwäche, Fibromyalgie, temporomandibuläre Störungen, andere) hinsichtlich Outcome Symptombesserung

6 Methodik

Die Ergebnisse aus der Suche in Medline wurden auf Reviews (Angabe in Medline) reduziert und daraus auf Abstractebene jene Reviews gelistet und kurz berichtet, die tatsächlich Studien zu Biofeedback enthalten.

Die Ergebnisse der Medline Suche wurden in Hauptkategorien zusammengefasst: Defäkationsstörungen, Herz-Kreislaufprobleme, Schmerzen, neurologische Störungen, psychische Störungen, Anderes. Der Bereich Biofeedback für Störungen im Bereich des Urogenitalsystems wurde nicht beachtet, da zu diesem Thema bereits eine Arbeit aus der Abteilung EBH existiert.

Inkludiert wurden nur Reviews, die Biofeedback als Intervention oder Teil einer Intervention diskutieren.

Exkludiert wurden Einzelstudien, Case studies mit Literaturreview und Reviews ohne Hinweis auf Biofeedback im Abstract.

In einem weiteren Schritt wurde in Kurzform die Kernaussage des jeweiligen Reviews, wie sie im Abstract dargestellt wird, erfasst, um die Eingrenzung der Fragestellung für Biofeedback zu erleichtern.

7 Suchstrategie

Search Strategy 8.3.2007

• Search	Most Recent Queries	Time	Result
#4	Search **"Biofeedback (Psychology)"[MeSH]** Limits: **only items with abstracts, English, German, published in the last 10 years, Humans**	05:37:02	1105
#3	Search **"Biofeedback (Psychology)"[MeSH]** Limits: **only items with abstracts, Humans**	05:34:34	3176
#2	Search **"Biofeedback (Psychology)"[MeSH]**	05:33:38	4709

à reviews 288 à only reviews extracted

Die Suche nach dem Begriff „Biofeedback“ in Medline ergab 4,709 Treffer, eingeschränkt auf Studien an Menschen; an Studien mit Abstract, Studien aus den letzten zehn Jahren und Studien in Englisch oder Deutsch verbleiben 1,105. Unter diesen 1,105 sind 288 Reviews, die prioritär selektiert werden, um eine Anfrageerstellung zu generieren.

8 Kardiovaskuläre Erkrankungen

In Bezug auf Biofeedback werden nachfolgend die einzelnen Reviews nach untersuchter Patientengruppe, Art der Outcomemessung und Aussage dargestellt

	Patienten	Outcome	Aussage der Studie
48: Geurts AC et al. A review of standing balance ...[PMID: 16214666]	Patienten nach Schlaganfall	Wiederherstellung der Stehbalance	Keine definitiven Rückschlüsse
78: Van Peppen RP et al. The impact of physical therap...[PMID: 15609840]	Patienten nach Schlaganfall	Funktionelle Verbesserung	Kein Beweis
89: Barclay-Goddard R et al. Force platform feedback for s...[PMID: 15495079]	Patienten nach Schlaganfall	Haltungskontrolle	Verbesserung
107: Stein J. Motor recovery strategies aft...[PMID: 15118963]	Patienten nach Schlaganfall	Funktionelle Verbesserung	Kann bei jungen Patienten Verbesserung erzielen
141: Pollock A et al. Physiotherapy treatment appro...[PMID: 12804415]	Patienten nach Schlaganfall	Haltungskontrolle	Keine Unterschiede zwischen verschiedenen Behandlungen
148: Chae J. Neuromuscular electrical stim...[PMID: 12625640]	Patienten nach Schlaganfall	Wiederherstellung motorischer Funktionen	Keine klare Aussage
180: Mauritz KH. Gait training in hemiplegia....[PMID: 11918646]	Patienten nach Schlaganfall	Wiederherstellung des Gangmusters	Verbesserung
213: Chae J et al. A critical review of neuromus...[PMID: 11067576]	Patienten nach Schlaganfall	Motorische Funktion	Wirkung unsicher
250: Miller RM et al. Advances in the management of...[PMID: 10573716]	Patienten nach Schlaganfall	Schluckbeschwerden	„gibt Hoffnung“
287: Nichols DS. Balance retraining after stro...[PMID: 9149764]	Patienten nach Schlaganfall	Gleichgewicht, Haltungskontrolle	Visualisierung des Lernens
3: Schwickert M et al. [Stress management in the tre...[PMID: 17168187]	Patienten mit arterieller Hypertonie	Stressabbau	Effekt bestätigt
245: Reyes del Paso GA. A biofeedback system of baror...[PMID: 10553484]	Patienten mit cardiac reflex sensitivity	Analyse der Baroreceptor Herz Reflex Function	On-line Messung ist akkurat
111: Kranitz L et al. Biofeedback applications in t...[PMID: 15078588]	Patienten mit cardiovasculären Erkrankungen	Management der chronischen Erkrankung	Eventuelle Alternative zu Standardmethoden
30: Linden W et al. The efficacy of behavioral tr...[PMID: 16565886]	Patienten mit Hypertonie	Reduzierung des Blutdrucks	thermisches feedback und Hautwiderstand Feedback sind wirksam; EMG oder direktes Blutdruck Feedback haben keinen Effekt
192: Davis MM et al. The role of lifestyle managem...[PMID: 11785067]	Patienten mit Hypertonie	Management der chronischen Erkrankung	Empfehlung für Lifestyle Änderung
263: Buselli EF et al. Influence of psychosocial fac...[PMID: 10098006]	Patienten nach Myokardinfarkt	„verbesserte Outcomes“	Unklare Aussage
142: Galper DI et al. Current status of mind-body i...[PMID: 12802126]	Patienten mit Gefäß-komplikationen bei Diabetes	Verbesserung der peripheren Durchblutung, Schmerzen, Neuropathie, Heilung von Geschwüren, Gehaktivität, Lebensqualität	wirksam

8.1 Teilbereich Schlaganfall Nachbehandlung

Geurts et al[2] 2005

Studies dealing with the recovery of standing balance from stroke are, however, limited to rehabilitation inpatients with a unilateral supratentorial brain infarction or haemorrhage. No information is available about the role of stepping responses as an alternative to equilibrium reactions for restoring the ability to maintain upright stance after stroke. The finding that **brain lesions involving particularly the parieto-temporal junction are associated with poor postural control**, suggests that normal sensory integration is critical for balance recovery. Despite a considerable number of intervention studies, **no definitive conclusions can be drawn about the best approach to facilitate the natural recovery of standing balance following stroke**.

Van Peppen et al[3] 2004

OBJECTIVE: To determine the evidence for physical therapy interventions aimed at improving functional outcome after stroke. RESULTS: In total, 151 studies were included in this systematic review; 123 were randomized controlled trials (RCTs) and 28 controlled clinical trials (CCTs). Methodological quality of all RCTs had a median of 5 points on the 10-point PEDro scale (range 2-8 points). **Based on high-quality RCTs strong evidence was found in favour of task-oriented exercise training to restore balance and gait, and for strengthening the lower paretic limb**. Summary effect sizes (SES) for functional outcomes ranged from 0.13 (95% CI 0.03-0.23) for effects of high intensity of exercise training to 0.92 (95% CI 0.54-1.29) for improving symmetry when moving from sitting to standing. **Strong evidence** was also found for therapies that were focused on **functional training** of the upper limb **such as constraint-induced movement therapy** (SES 0.46; 95% CI 0.07-0.91), **treadmill training** with or without body weight support, respectively 0.70 (95% CI 0.29-1.10) and 1.09 (95% CI 0.56-1.61), **aerobics** (SES 0.39; 95% CI 0.05-0.74), **external auditory rhythms during gait** (SES 0.91; 95% CI 0.40-1.42) and **neuromuscular stimulation for glenohumeral subluxation** (SES 1.41; 95% CI 0.76-2.06). **No or insufficient evidence in terms of functional outcome was found for**: traditional neurological treatment approaches; exercises for the upper limb; **biofeedback**; functional and neuromuscular electrical stimulation aimed at improving dexterity or gait performance; orthotics and assistive devices; and physical therapy interventions for reducing hemiplegic shoulder pain and hand oedema. CONCLUSIONS: This review showed small to large **effect** sizes **for task-oriented exercise training**, in particular when applied intensively and early after stroke onset. In almost all high-quality RCTs, effects were mainly restricted to tasks directly trained in the exercise programme.

Barcley-Goddard et al[4] 2004 (Cochrane Review)

OBJECTIVES: To determine if visual or auditory force platform feedback improves

the clinical and force platform standing balance outcomes in clients with stroke. (…) MAIN RESULTS: We included seven trials (246 participants). Force platform feedback did not improve clinical measures of balance when moving or walking (Berg Balance Scale and Timed Up and Go). **Significant improvements in laboratory force platform indicators of stance symmetry were found for regimens using visual feedback** (standardised mean difference (SMD) -0.68, 95% confidence interval (CI) -1.31 to -0.04, p = 0.04) **and the concurrent visual and auditory feedback** (weighted mean difference (WMD) -4.02, 95% CI -5.99 to -2.04, p = 0.00007). There were **no significant effects on laboratory postural sway indicators, clinical outcomes or measures of function at follow-up assessment**. REVIEWERS' CONCLUSIONS: **Force platform feedback (visual or auditory) improved stance symmetry but not sway in standing, clinical balance outcomes or measures of independence**.

Stein[5] 2004:

Impaired motor function after stroke is a major cause of disability in young stroke survivors. The plasticity of the adult human brain provides opportunities to enhance traditional rehabilitation programs for these individuals. **Younger stroke patients appear to have a greater ability to recover from stroke and are likely to benefit substantially from treatments that facilitate plasticity-mediated recovery**. The use of new **exercise treatments**, such as **constraint-induced movement therapy**, **robot-aided rehabilitation, and partial body weight supported treadmill training are** being studied intensively and are **likely to ultimately be incorporated into standard poststroke rehabilitation**. Medications to enhance recovery, growth factors, and stem cells will also be components of rehabilitation for the young stroke survivor in the foreseeable future.

Pollock et al[6] 2003: (Cochrane Review)

OBJECTIVES: To determine if there is a difference in the recovery of postural control and lower limb function in patients with stroke if physiotherapy treatment is based on orthopaedic or neurophysiological or motor learning principles, or on a mixture of these treatment principles. (…) MAIN RESULTS: Eleven trials were included in the review, three of which were included in two comparisons. Four trials compared a neurophysiological approach with another approach; four trials compared a motor learning approach with another approach; four studies compared a mixed approach with another approach; two trials reported comparisons of sub-groups of the same approach. A large number of heterogeneous outcome measures were used, limiting the comparison of trial results. No one type of approach had a significantly better outcome than any other type of approach. REVIEWER'S CONCLUSIONS: **There is insufficient evidence to conclude that any one physiotherapy treatment approach is more effective than another in promoting the recovery of postural control or lower limb function**.

Chae[7] 2003

Neuromuscular electrical stimulation may have an important role in improving the motor function of stroke survivors. Active, repetitive movement training mediated by transcutaneous cyclic and EMG-triggered NMES (Portable Neuromuscular Electrical Stimulation) may facilitate the motor recovery of stroke survivors. Multicenter, double-blinded, randomized clinical trials should be pursued to confirm the motor-relearning effects of transcutaneous NMES and to define appropriate prescriptive specifications. Intramuscular EMG-controlled NMES may be superior to transcutaneous systems and is presently undergoing preliminary randomized clinical trials. Neuroprostheses systems may provided the highest level of goal-oriented activity and cognitive investments, which may lead to significant motor relearning. Implementation of clinically viable neuroprosthesis systems, however, will probably require additional technical developments including more reliable control paradigms and methods for blocking undesirable muscle contractions. **In view of the dynamic nature of the present health care environment, the future of NMES technology is difficult to predict. By necessity, scientists and clinicians must continue to explore new ideas and to improve on the present systems.** Components will be smaller, more durable, and more reliable. Control issues will remain critical for both motor relearning and neuroprosthetic applications, and the implementation of cortical control is likely to dictate the nature of future generations of NMES systems. Finally, consumers will direct future developments. In the present health care environment, where cost has become an overwhelming factor in the development and implementation of new technology, the consumer will become one of technology's greatest advocates. **The usual drive toward greater complexity will be tempered by the practical issues of clinical implementation, where patient acceptance is often a function of a tenuous balance between the burden or cost associated with using a system and the system's impact on the user's life.**

Mauritz[8] 2002:

Restoration of gait is a major goal in neurological rehabilitation. Before starting therapy, a comprehensive assessment is necessary to evaluate the deficits and remaining functions. A wide variety of therapeutic procedures are available and have to be adapted to the individual situation - different concepts of physiotherapy stress different features like: force exercise, reduction of spasticity, gait symmetry, utilization of equilibrium reflexes, stepping automation, endurance training, repetition of rhythmic movements, etc. The spectrum of available therapies was recently widened by treadmill training, with partial body-weight support, locomotor pharmacotherapy, selective reduction of spasticity by botulinum toxin injections, and by musical biofeedback, which have each proved to be successful in the restoration of gait pattern. **Treadmill training based on partial body weight support, combined with enforced stepping movements has proved to be successful in the restoration of gait pattern.** A common problem in hemiparetic gait, is the spastic inversion of the foot. If spasticity is not severe, an ankle-foot orthosis (AFO) is the appropriate technical aid. **In other cases, botulinum toxin injection into spastic leg muscles**

has been successfully used to improve gait functions. In hemiparetic stroke patients, auditory (musical) rhythm, as a peripheral pacing signal, resulted in a significant increase in weight-bearing stance time on the paretic side. In addition, there was an improved stride symmetry with rhythmic cueing and a normalizations of gait pattern. **These methods directed to gait improvement should be combined and adapted to the individual patient's needs, in order to obtain the best results.**

Chae[9] 2000:

The purpose of this review is to critically assess the clinical efficacy of neuromuscular electrical stimulation in treating motor dysfunction in hemiplegia. Three distinct applications are reviewed in the areas of motor relearning, shoulder dysfunction, and neuroprostheses. Assessment of clinical efficacy and recommendations on clinical implementation are based on the weight of published scientific evidence. With respect to motor relearning, evidence supports the use of neuromuscular electrical stimulation to facilitate recovery of muscle strength and coordination in hemiplegia. **However, effects on physical disability are uncertain**. With respect to shoulder dysfunction, neuromuscular electrical stimulation decreases shoulder subluxation, at least in the short term. However, effects on shoulder pain and disability are also uncertain. With respect to neuroprosthesis systems, clinically deployable upper extremity systems must await the development of more sophisticated control methods and greater fundamental understanding of motor dysfunction in hemiplegia. The evidence for clinical feasibility of lower extremity neuroprostheses is stronger, and investigations on clinical efficacy should be pursued. In summary, **the application of neuromuscular electrical stimulation for motor relearning and shoulder dysfunction are ready for more rigorous scientific and clinical assessment via large, multicenter, randomized clinical trials**. However, additional investigations are needed to demonstrate the clinical feasibility of neuroprostheses applications.

Miller[10] 1999:

This article reviews the advancements that have occurred, primarily in the last decade, in the management and treatment of swallowing disorders related to stroke. An overview of swallowing physiology is given, and interventions, both indirect and direct, are explored. Expanding knowledge, applying techniques from other scientific disciplines, and **developing new technologies provide hope** for stroke patients who experience dysphagia.

Nichols[11] 1997

All of these components steadiness, symmetry, and dynamic stability of balance have been found to be disturbed following stroke. Recent advances in technology have resulted in the commercial availability of numerous force platform systems for the retraining of balance function in patient populations, including patients with stroke. These systems are designed to provide visual or auditory biofeedback to

patients regarding the locus of their center of force (COF) or center of pressure (COP), as well as training protocols to enhance stance symmetry, steadiness, and dynamic stability. **Typical force platform biofeedback systems consist of at least two force plates to allow the weight on each foot to be determined, a computer and monitor to allow visualization of the COF or COP, and software that provides training protocols and data analysis capabilities. Some units allow auditory feedback in addition to the visual feedback in response to errors in performance**.

8.1.1 Zusammenfassung Schlaganfall:

Es können keine definitiven Aussagen über die beste Unterstützung bei Balancestörungen nach Schlaganfall getroffen werden. (Geurts 2005)

Van Peppen et al. finden gute Evidenz für Funktionstraining durch Bewegungstherapie, Tretmühltraining, Aerobic, hörbare Rhythmusunterstützung beim Gehen und neuromuskuläre Stimulation bei Schulterluxation und keine oder unzureichende Evidenz hinsichtlich funktionellen Outcomes für aufgelistete andere Methoden inklusive Biofeedback.

Force Plattform Feedback kann die Haltungssysmmetrie verbessern, nicht jedoch die Haltungskontrolle, Gleichgewicht und Selbständigkeit beim Stehen. (Barcley-Goddard 2004).

Junge Patienten haben bessere Rehabilitationschancen nach Schlaganfall und profitieren von Behandlungen wie Übungs- und Bewegungstherapie, technikunterstützter Rehabilitation und Tretmühl Training. Diese Methoden sollten daher in die Standard Rehabilitation nach Schlaganfall integriert sein. (Stein 2004).

Pollock et al (2003) finden unzureichende Evidenz für die Aussage, eine Art der physiotherapeutischen Behandlung sei die bessere im Vergleich zu einer anderen. Der Review ist durch große Methodenvielfalt und Kombinationsvielfalt in den Studien begrenzt.

Chae (2003) bespricht vor allem die klinische Nutzbarkeit der NMES (Portable Neuromuscular Electrical Stimulation) innerhalb der gegenwärtigen Gesundheitssysteme hinsichtlich Kosteneffektivität und Patientenakzeptanz und hält eine Prognose darüber für schwierig.

Verschiedene Arten der Bewegungstherapie (Tretmühltraining, forcierte Schrittübungen) führen zur erfolgreicher Rehabilitation von Beeinträchtigungen des Gehens, Therapien der Spastizität mit Botulinum Toxin und auditive Rhythmusunterstützung beim Gehen mit Hemiparese zeigen gute Erfolge in der Rehabilitation nach Schlaganfall. (Mauritz 2002).

8.2 Teilbereich andere kardiovaskuläre Erkrankungen (ausgenommen Schlaganfall)

Schwickert[12] 2006

Between 60 and 90% of patients consult their family doctor for stress-associated complaints. Not infrequently, a considerable number of these patients already have elevated blood pressure. **The positive effect on high blood pressure of relaxation techniques has been confirmed in various studies**. Accordingly, stress management should now have a permanent place in effective antihypertensive treatment. **Appropriate relaxation techniques include, for example, autogenic training, progressive muscle relaxation, visualization and breathing exercises, chi gong and yoga.**These practices are incorporated in various lifestyle programs.They act in different ways, and can be offered to the patient in accordance with his/her individual wishes.

Reyes del Paso[13] 1999

The baroreceptor reflex is a basic mechanism for the regulation of blood pressure, a powerful source of vagal afferent input to the central nervous system, and one of the most important physiological mechanisms affecting efferent cardiac vagal activity. This paper describes a computerized system for the on-line analysis of the baroreceptor cardiac reflex function using the noninvasive spontaneous sequence method in the time domain. The system provides feedback of the baroreceptor reflex sensitivity (the change in heart period per unit change in systolic blood pressure) differentially both when the systolic blood pressure is increasing and when it is decreasing. The accuracy of the described system has been tested against the conventional off-line procedure. None of the parameters supplied by the analysis show a significant difference between the on-line and off-line methods. These results **confirm the accuracy of the on-line** system to **analyze baroreceptor cardiac reflex function**.

Kranitz[14] 2004

Various methods of biofeedback have shown promise in the treatment or management of several cardiovascular disorders. The literature relating to the use of biofeedback therapies for hypertension, cardiac arrhythmias, angina pectoris, cardiac ischemia, myocardial infarction, and Raynaud's phenomenon is reviewed. The number and types of studies in each of these areas vary widely, but research to date suggests that **biofeedback could be a useful alternative or adjunct to more conventional forms of treatment**. Further research to clarify the appropriate uses of biofeedback in the management of these disorders is recommended.

Linden[15] 2006

Evidence is reviewed for the efficacy of behavioral treatments for hypertension. The format chosen here is a review of reviews given that numerous consensus committee

reports and quantitative reviews on the topic have been published. **Extensive evidence from over 100 randomized controlled trials indicates that behavioral treatments reduce blood pressure (BP) to a modest degree, and this change is greater than what is seen in wait-list or other inactive controls.** Effect sizes are quite variable. The observed BP reductions are much greater when BP levels were high at pre-test, and behavioral studies tend to underestimate possible benefits because of floor effects in their protocols. Blood pressure measured in the office may be confounded with measurement habituation. Multi-component, individualized psychological treatments lead to greater BP changes than do single-component treatments. **Among biofeedback treatments, thermal feedback and electrodermal activity feedback fare better than EMG or direct BP feedback, which tend to produce null effects**. There continues to be a scarcity of strong protocols that properly control for floor effects and potential measurement confounds.

Davis[16] 2002

The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNCVI) includes recommendations for prevention and management of hypertension. Recommendations include reducing sodium intake, increasing potassium, calcium, and magnesium intake, controlling obesity, and avoiding heavy alcohol intake, along with aggressive BP control. **JNCVI guidelines provide a reasonable approach to lifestyle interventions, the benefits of which would outweigh the antihypertensive effects.** The data suggest that such guidelines would benefit normotensive people as well.

Galper[17] 2003

Impaired peripheral blood flow causes complications, disabilities, expenses, and deaths among persons with diabetes mellitus. Many individuals suffer from lower-extremity pain, reduced functional status, and impaired quality of life. Current conventional treatments include lifestyle modification, exercise, medication, and surgery. However, these approaches are often impractical or insufficient. **Thermal biofeedback, however, alone or in conjunction with other mind-body techniques, improves peripheral circulation, pain, neuropathy, ulcer healing, ambulatory activity, and quality of life.** It is noninvasive, inexpensive, and consistent with community-based approaches to diabetes self-management. As an adjunct to the medical management of diabetes, thermal biofeedback may help ameliorate some of the vascular complications.

Buselli[18] 1999

Management of the myocardial infarction patient may extend beyond the physiologic to include psychosocial factors that may adversely affect cardiac health. Psychosocial factors such as depression, coronary-prone behavior, hostility, social isolation, anxiety, anger, and stress are related to increased cardiac death and illness. Various interventions including cognitive-behavioral therapies, techniques

that elicit the relaxation response, meditation, exercise, and increasing social networks, **may play a role in improving health outcomes**. This article explores the relationship of these psychosocial factors to cardiac health and proposes a biopsychosocial model of care.

8.2.1 Zusammenfassung andere Kardiovaskuläre Erkrankungen

Die Aussagen in den Studien sind sehr vage und unklar und reichen von Biofeedback „könnte eine Rolle spielen“ (Buselli 1999; Kranitz 2004) zu Bericht der Wirksamkeit (ohne Qualitätsangabe über die dahinterliegenden Studien) (Schwickert 2006, Linden 2006 für thermisches Feedback und Hautwiderstand; Galper 2003; Rayes del Paso 1999; Davis 2002) und Unwirksamkeit (Linden 2006 für EMG und direktes Feedback), jedenfalls ohne klare Argumentation.

9 Defäkationsstörungen

	Patienten mit	Outcome	Aussage der Studie
146: Jorge JM et al. Biofeedback therapy in the co...[PMID: 12737096]	Inkontinenz, Verstopfung, rektale Schmerzen	Beschwerdefreiheit	Einfache günstige und nebenwirkungsfreie Therapieart
1: Wald A. Chronic constipation: advance...[PMID: 17187583]	Konstipation	Normalfunktion	Keine klare Aussage im Abstract
122: Stessman M. Biofeedback: its role in the ...[PMID: 14676613]	Konstipation	Normalfunktion	Biofeedback ist aufwendig, aber erfolgreich
127: Heymen S et al. Biofeedback treatment of cons...[PMID: 12972965]	Konstipation	Effekt	Wenig qualitativ gute Studien, wenig klare Ergebnisse
128: Sanmiguel CP et al. Constipation caused by functi...[PMID: 12959723]	Konstipation	Normalfunktion	Biofeedback ist die am meisten spezifische therapeutische Modalität und sicher
133: Rao SS. Constipation: evaluation and ...[PMID: 12858610]	Konstipation	Normalfunktion	Bevorzugte Therapie, nicht breit verfügbar
202: Schiller LR. Review article: the therapy o...[PMID: 11380313]	Konstipation	Normalfunktion	Biofeedback ist eine verwendete Therapiemethode
208: Brooks RC et al. Review of the treatment liter...[PMID: 11211851]	Konstipation bei Kindern	Normalfunktion	Keine Evidenz für die Wirksamkeit von Psychotherapie und Sphinkter Biofeedback
217: Wofford SA et al. Approach to patients with ref...[PMID: 10998666]	Konstipation	Normalfunktion	Kleine klare Aussage
218: Nurko S. Advances in the management of...[PMID: 10957935]	Konstipation	Diagnose und Therapie	Keine klare Aussage im Abstract
224: McGrath ML et al. Empirically supported treatme...[PMID: 10814690]	Konstipation und Inkontinenz	Therapiearten	Keine gut fundierte Intervention. Biofeedback mit Medikation – Methoden erreichen Kriterien gewisser Wirksamkeitskategorien
4: Chiarioni G et al. Biofeedback therapy for dyssy...[PMID: 17131466]	Defäkationsstörungen	Normalfunktion	Biofeedback ist wirksam bei Erwachsenen, nicht aber bei Kindern
12: Remes-Troche JM et al. Defecation disorders: neuromu...[PMID: 16888870]	Defäkationsstörungen	Normalfunktion	Die mögliche Behandlung beinhaltet auch Biofeedback

195: Brazzelli M et al. Behavioural and cognitive int...[PMID: 11687154]	Defäkationsstörungen bei Kindern	Normalfunktion	Keine Evidenz für einen Vorteil von Biofeedback gegenüber konventioneller Therapie
277: Rao SS. The technical aspects of biof...[PMID: 9660527]	Defäkationsstörungen	Normalfunktion	Die Wirksamkeit von Biofeedback wird mit 70-80% berichtet
285: Barlow JD. Biofeedback in the treatment ...[PMID: 9187872]	fäkaler Inkontinenz	Funktionsverbesserung	Biofeedback ist eine Option, aber die Motivation des Patienten ist dabei von grundlegender Wichtigkeit
15: Norton C et al. Biofeedback and/or sphincter ...[PMID: 16855987]	fäkaler Inkontinenz	Funktionsverbesserung	Methodische Schwächen lassen keinen seriösen Rückschluss auf die Wirksamkeit zu
24: Brazzelli M et al. Behavioural and cognitive int...[PMID: 16625557]	fäkaler Inkontinenz	Funktionsverbesserung	Keine Evidenz
52: Chiarioni G et al. Bio-feedback treatment of fec...[PMID: 16097042]	fäkaler Inkontinenz	Funktionsverbesserung	Bis zu 70% Kurzzeiterfolg berichtet, aber keine RCTs bestätigen diese Erfahrung
130: Tariq SH et al. Fecal incontinence in the eld...[PMID: 12935828]	fäkaler Inkontinenz	Funktionsverbesserung	Biofeedback ist bei älteren Patienten machbar
132: Hinninghofen H et al. Fecal incontinence: evaluatio...[PMID: 12858611]	fäkaler Inkontinenz	Funktionsverbesserung	Biofeedback ist bei den meisten Patienten erfolgreich und hat keine Nebenwirkungen
152: Kroesen AJ et al. [Biofeedback in faecal incont...[PMID: 12552403]	fäkaler Inkontinenz	Funktionsverbesserung	Gut etablierte Methode zur Behandlung von fäkaler Inkontinenz
183: Rudolph W et al. A practical guide to the diag...[PMID: 11888031]	fäkaler Inkontinenz	Funktionsverbesserung	Management der fäkalen Inkontinenz beinhaltet auch Biofeedback
198: Norton C et al. Anal sphincter biofeedback an...[PMID: 11472317]	fäkaler Inkontinenz	Funktionsverbesserung	Die Daten unterstützen die Annahme, dass Biofeedback und Übungen wirksam sind – die Studienqualität weist Lücken auf
204: Norton C et al. Methodology of biofeedback fo...[PMID: 11337702]	fäkaler Inkontinenz	Funktionsverbesserung	2/3 der Patienten berichten Verbesserung
219: Soffer EE et al. Fecal incontinence: a practic...[PMID: 10950029]	fäkaler Inkontinenz	Funktionsverbesserung	Effektiv bei den meisten Patienten
226: Norton C et al. Biofeedback and/or sphincter ...[PMID: 10796859]	fäkaler Inkontinenz	Funktionsverbesserung	Biofeedback und Übungen können einen Effekt haben, eine sichere Aussage darüber ist nicht möglich
228: Hosker G et al. Electrical stimulation for fa...[PMID: 10796769]	fäkaler Inkontinenz	Funktionsverbesserung	Insuffiziente Daten erlauben keinen Rückschluss

43: Andrews CN et al. The etiology, assessment, and...[PMID: 16355157]	fäkaler Inkontinenz	Funktionsverbesserung	Biofeedback könnte nützlich sein
116: Norton C. Behavioral management of feca...[PMID: 14978640]	fäkaler Inkontinenz	Funktionsverbesserung	Bis zu 50% Symptomminderung, aber methodische Mängel der Studien
281: Bassotti G et al. Biofeedback, relaxation train...[PMID: 9327034]	Gastrointestinalen Beschwerden	Funktionsverbesserung	Biofeedback und Verhaltenstherapien spielen zunehmend eine Rolle in der Behandlung
246: Read NW. Harnessing the patient's powe...[PMID: 10580923]	Reizdarmsyndrom	Psychologische Annäherung	Keine klare Aussage über Biofeedback im Abstract
88: Palsson OS et al. Biofeedback treatment for fun...[PMID: 15497616]	Konstipation	Funktionsverbesserung	Biofeedback ist Standardtherapien überlegen im Fall von kindlicher Verstopfung und möglicherweise wirksam bei fäkaler Inkontinenz bei Erwachsenen

Jorge[19] 2003

In coloproctology, **biofeedback has been used for more than 20 years to treat patients with fecal incontinence, constipation, and rectal pain**. It can be performed in a number of conditions **with minimal risk and discomfort**. However, it does require the presence of some degree of sphincter contraction and rectal sensitivity. Biofeedback can be time-consuming and demands motivation. The purpose of this paper is to review the indications, methodology, and results of anorectal biofeedback in the treatment of these disorders. Mean success rates for biofeedback range from 72.3% for fecal incontinence of diverse etiology, 68.5% for constipation attributable to paradoxical puborectalis syndrome, and 41.2% for idiopathic rectal pain. **However, criteria to define success vary tremendously among researchers and there is a tendency to indicate biofeedback in a myriad of conditions when other therapeutic options, including surgery, fail or are inappropriate. These factors make comparison of the results difficult and reinforce the need for randomized controlled trials and studies assessing long-term follow-up**. In summary, **biofeedback is a simple, cost-effective, and morbidity-free technique and remains an attractive option**, especially considering the complexity of the functional disorders of the colon, rectum, anus, and pelvic floor.

Wald 2007

Only a relatively small percentage of clinically constipated patients seek medical attention and most can be managed satisfactorily with conservative measures. This review mainly addresses those patients who have refractory or difficult-to-manage functional constipation who are referred to gastrointestinal specialists. Areas of review include insights into pathophysiology, the utility of diagnostic testing and the author's opinions concerning available pharmacologic agents, **the role of behavioural therapies** and the indications for surgical interventions in this heterogeneous group of patients.

Stessman[20] 2003

Constipation accounts for more than 2.5 million physician visits a year. Treatment of constipation has been a long-standing and costly problem. Affecting approximately 4.5 million Americans, predominantly women and the elderly, constipation can be persistent and difficult to manage. With the great number of laxative products available, more than $350 to $400 million is spent on over-the-counter laxatives each year. In addition to a complete history and physical examination, tests of anorectal function are useful in the assessment of defecation disorders**. Approximately 50% of patients exhibit uncoordinated or dyssynergic defecation patterns. Biofeedback therapy may improve the symptoms of these patients. Biofeedback therapy is labor-intensive, expensive, and available only at a few centers.** Although the concept of dyssynergic defecation has existed for only a few years, its therapy, based on neuromuscular conditioning, is gaining recognition. The biofeedback program from one Midwestern tertiary care center is described. Although much still needs to be learned regarding the etiology and pathophysiology of

dyssynergic defecation, its management with **biofeedback is shown to be efficacious** and may prove to be the treatment of choice for patients with this dysfunction of the pelvic floor.

Heymen[21] 2003

Although most studies report positive results using biofeedback to treat constipation, quality research is lacking. Specific recommendations are made for future investigations to 1) improve experimental design, 2) clearly define outcome measures, 3) identify the etiology and severity of symptoms, 4) determine which treatment protocol and which component of treatment is most effective for different types of subjects, 5) systematically explore the role of psychopathology in this population, 6) use an adequate sample size that allows for meaningful analysis, and 7) include long-term follow-up data.

Sanmiguel[22] 2003

Functional constipation is a very common problem in Western societies. Functional outlet obstruction, part of the spectrum of functional constipation, is suspected when patients present with select symptoms. Diagnosis is commonly made with anorectal manometry, electromyography, and rectal evacuation tests. Abnormal test patterns include poor relaxation and contraction of the anal sphincter in response to attempted defecation and difficult rectal evacuation. Several treatment approaches have been tested in these patients. **Biofeedback training is considered the most specific therapeutic modality, and it is particularly attractive because of its safety**. This review provides an assessment of the diagnostic tests for functional outlet obstruction and summarizes current options for therapy.

Rao[23] 2003

Constipation is a common clinical problem that comprises a constellation of symptoms that include excessive straining, hard stools, feeling of incomplete evacuation, use of digital maneuvers, or infrequent defecation. Although many conditions, such as metabolic problems, fiber deficiency, anorectal problems, and drugs, can cause constipation, when excluded functional constipation consists of two subtypes: slow-transit constipation and dyssynergic defecation. Some patients with irritable bowel syndrome may exhibit features of both types of constipation. The Rome criteria for functional constipation together with modifications proposed here for dyssynergic defecation may serve as useful guidelines for making a diagnosis. Recent advances in technology, together with a better understanding of the underlying mechanisms, have led to real progress in the diagnosis of this condition. Management options are limited, however, and **evidence to support these treatments is only modest**. The treatment is primarily medical; surgical options should be reserved for refractory disease and after careful diagnostic work-up. Although laxatives remain the mainstay of therapy, prokinetics that are colon-selective are optimal for treating patients with slow-transit constipation, but they are not yet available for clinical use. Recent controlled trials, however, are promising.

Biofeedback therapy is the preferred treatment for patients with dyssynergia, but is not widely available. In the near future, user-friendly biofeedback programs including home therapy may facilitate wider use of these methods for patients with dyssynergic defecation.

Schiller[24] 2001

Constipation is a common symptom that may be idiopathic or due to various identifiable disease processes. Laxatives are agents that add bulk to intestinal contents, that retain water within the bowel lumen by virtue of osmotic effects, or that stimulate intestinal secretion or motility, thereby increasing the frequency and ease of defecation. Drugs which improve constipation by stimulating gastrointestinal motility by direct actions on the enteric nervous system are under development. **Other modalities used to treat constipation include biofeedback and surgery**. Laxatives and lavage solutions are also used for colon preparation and evacuation of the bowels after toxic ingestions.

Brooks[25] 2000

This review summarizes the literature on randomized, controlled, published studies involving medical, behavioral, psychological, and biofeedback treatments for encopresis/functional constipation and stool-toileting refusal in preschool-age and school-age children. Nine such studies were located in the literature involving school-age children. No randomized, controlled treatment studies involving preschool-age children have been published. **This review revealed no evidence to support the routine use of psychotherapy or anal sphincter biofeedback in the treatment of pediatric fecal elimination dysfunctions**, beyond those benefits derived from a comprehensive medical-behavioral intervention. Further, this review indicated that paradoxical constriction of the External Anal Sphincter does not influence the treatment outcome of either biofeedback or medical-behavioral interventions. There are remarkably few controlled treatment outcome studies in this most important clinical area. More research is needed that employs standard treatment outcome variables.

Wofford[26] 2000

Constipation is a very frequent problem, particularly in elderly patients. Constipation is a common reason for patients to seek medical advice, and it accounts for a large number of different prescription and over-the-counter medications. In many cases, no definite cause can be found. Most patients respond to conservative therapy with increased fiber and fluid intake alone. Patients with constipation that is more difficult to control or with alarm symptoms (eg, blood in stool, sudden onset, weight loss, or decreasing stool caliber) warrant further investigation. **A variety of medical, behavioral, and surgical therapies can be employed to help these more refractory patients.**

Nurko[27] 2000

Constipation in children is a common concern. There is no single treatment; many children do not respond and continue to have chronic problems. This lack of response is multifactorial, but it is most likely related to the fact that the exact pathophysiology of constipation in children is not known. Diagnostic criteria (Rome II classification) and algorithms proposed by the North American Society for Pediatric Gastroenterology and Nutrition (NASPGN) for evaluation and treatment of children with constipation were recently published and are summarized here. **The effectiveness of new treatments such as dietary interventions, prokinetic agents, biofeedback, and polyethylene-glycol electrolyte (PEG) solutions is discussed in this review.**

McGrath[28] 2000

OBJECTIVE: To review the empirical research examining behavioral and medical treatments for constipation and fecal incontinence. METHOD: Sixty-five articles investigating intervention efficacy were identified and reviewed. Twenty-three of the studies were excluded because they were case studies or were less well-controlled single-case designs. The intervention protocol for each study was identified and coded, with studies employing the same interventions matched and evaluated according to the Chambless criteria. RESULTS: **From the literature base to date, no well-established interventions have emerged.** However, four probably efficacious treatments and three promising interventions were identified. Two different medical interventions plus positive reinforcement fit the criteria for the probably efficacious category (one with fiber recommendation and one without). **Three biofeedback plus medical interventions fit efficacy category criteria**: one probably efficacious for constipation with abnormal defecation dynamics (full medical intervention plus biofeedback for paradoxical contraction), and two fit the promising intervention criteria for constipation and abnormal defecation dynamics (full medical intervention plus biofeedback for EAS strengthening, correction of paradoxical contraction and home practice; and biofeedback focused on correction of paradoxical contraction, medical intervention without fiber recommendation, and positive reinforcement). Two extensive behavioral interventions plus medical intervention also met efficacy criteria for constipation plus incontinence (medical intervention without laxative maintenance plus positive reinforcement, dietary education, goal setting, and skills building presented in a small-group format fits criteria for a promising intervention; and positive reinforcement and skills building focused on relaxation of the EAS during defecation, but without biofeedback, plus medical intervention meets the probably efficacious criteria). CONCLUSIONS: A discussion of the current weaknesses in this research area follows. Specific recommendations for future research are made including greater clarity in treatment protocol and sample descriptions, reporting cure rates rather than success rates, utilization of adherence checks, and investigation of potential differential outcomes for subgroups of children with constipation and incontinence.

Chiarioni[29] 2006

Dyssynergic defecation is (…) believed to be a behavioral disorder because there are no associated morphological or neurological abnormalities, and consequently biofeedback training has been recommended for treatment. Biofeedback involves the use of pressure measurements or averaged electromyographic activity within the anal canal to teach patients how to relax pelvic floor muscles when straining to defecate. (…). **In adults, randomized controlled trials show that this form of biofeedback is more effective than laxatives, general muscle relaxation exercises (described as sham biofeedback), and drugs to relax skeletal muscles. Moreover, its effectiveness is specific to patients who have dyssynergic defecation and not slow transit constipation. However, in children, no clear superiority for biofeedback compared to laxatives has been demonstrated.** Based on three randomized controlled studies in the last two years, biofeedback appears to be the preferred treatment for dyssynergic defecation in adults.

Remes-Troche[30] 2006

Chronic constipation and fecal incontinence affect 20% of the population and are more prevalent in women, the elderly, those of lower socioeconomic status, and nursing home residents. (…) These **treatments include biofeedback** therapy, tegaserod, and lubiprostone for chronic constipation.

Brazzelli[31] 2001 (Cochrane Review)

BACKGROUND: Faecal soiling is a common and potentially distressing disorder of childhood. OBJECTIVES: To assess the effects of behavioural and/or cognitive interventions for the management of defaecation disorders in children. (…)

The **synthesis of data from eight trials showed higher rather than lower rates of persisting problem up to 12 months when biofeedback was added to conventional treatment** (OR 1.34 CI 95% 0.92 to 1.94). In two trials significantly more encopretic children receiving behavioural intervention plus laxative therapy improved compared with those receiving behavioural intervention alone at both the 6-month (OR 0.51 CI 95% 0.29 to 0.89) and the 12-month follow-up (OR 0.52 CI 95% 0.30 to 0.93). **Similarly in another trial the addition of behaviour modifications to laxative therapy was associated with a marked reduction in children's soiling episodes** (OR 0.14 CI 95% 0.04 to 0.51). REVIEWER'S CONCLUSIONS: **There is no evidence that biofeedback training adds any benefit to conventional treatment in the management of encopresis and constipation in children.** There is some evidence that behavioural intervention plus laxative therapy, rather than behavioural intervention or laxative therapy alone, improves continence in children with primary and secondary encopresis.

Rao[32] 1998

Neuromuscular conditioning using biofeedback techniques is a useful method of

treatment for patients with refractory defecation disorders such as fecal incontinence or constipation with obstructive defecation. This article provides current perspectives regarding the principles and techniques of performing biofeedback therapy. (…) The three modalities that are commonly used for neuromuscular conditioning are visual, verbal, and audio feedback. Ideally, the training program should be customized for each patient based on the underlying dysfunction(s). **After biofeedback therapy, symptomatic improvement has been reported in 70 to 80% of patients with either incontinence or obstructive defecation. Recent studies also demonstrated objective improvement in anorectal function.** In the future, it is likely that simpler and user-friendly, solid-state computerized systems may facilitate a wider use of this treatment.

Barlow[33] 1997

Faecal incontinence is a distressing condition that affects approximately 1% of the population. Poor anal canal function can be determined by physiological testing using manometry and electromyographic techniques. Surgical repair of the anal canal does not always restore continence but biofeedback training either alone or in combination with other techniques such as muscle stimulation allows restoration of some degree of functional integrity of the anal canal musculature. **Biofeedback training offers a non-surgical approach to incontinence with good success rates and prolonged after benefits. However, patient motivation is crucial as the exercise techniques taught need to be continued on a permanent basis if continence is to be maintained.**

Norton[34] 2000 (Cochrane Review)

(…) OBJECTIVES: To determine the effects of biofeedback and/or anal sphincter exercises/pelvic floor muscle training for the treatment of faecal incontinence in adults. (…) MAIN RESULTS: Eleven eligible studies were identified with a total of 564 participants. In all but three trials **methodological quality was poor or uncertain**. **No study reported a major difference in outcome** between any method of biofeedback or exercises and any other method, or compared to other conservative management. There are suggestions that rectal volume discrimination training improves continence more than sham training and that anal biofeedback combined with exercises and electrical stimulation provides more short-term benefits than vaginal biofeedback and exercises for women with obstetric-related faecal incontinence. Further conclusions are not warranted from the available data. AUTHORS' CONCLUSIONS: The limited number of identified trials together with their **methodological weaknesses do not allow a definitive assessment of the possible role of anal sphincter exercises and biofeedback therapy in the management of people with faecal incontinence**. We found no evidence of biofeedback or exercises enhancing the outcome of treatment compared to other conservative management methods.

Brazzelli[35] 2006 (Cochrane Review)

(…) OBJECTIVES: To assess the effects of behavioural and/or cognitive interventions for the management of faecal incontinence in children. (…) MAIN RESULTS: Eighteen randomised trials with a total of 1168 children met the inclusion criteria. Sample sizes were generally small. All studies but one investigated children with functional faecal incontinence. (…).Combined results of nine trials showed **higher rather than lower rates of persisting symptoms** of faecal incontinence up to 12 months when biofeedback was added to conventional treatment (OR 1.11 CI 95% 0.78 to 1.58). (...). In one trial the adjunct of anorectal manometry to conventional treatment did **not result in higher success rates** in chronically constipated children (OR 1.40 95% CI 0.72 to 2.73 at 24 months).In one small trial the adjunct of behaviour modification to laxative therapy was associated with a significant reduction in children's soiling episodes at both the three month (OR 0.14 CI 95% 0.04 to 0.51) and the 12 month assessment (OR 0.20 CI 95% 0.06 to 0.65). AUTHORS' CONCLUSIONS: **There is no evidence that biofeedback training adds any benefit to conventional treatment in the management of functional faecal incontinence in children.** There was not enough evidence on which to assess the effects of biofeedback for the management of organic faecal incontinence. There is some evidence that behavioural interventions plus laxative therapy, rather than laxative therapy alone, improves continence in children with functional faecal incontinence associated with constipation.

Chiarioni[36] 2005

In the last years, numerous evidences have been reported on the efficacy of **bio-feedback technique**s for the treatment of this disorder. Overall, the literature data claim **a success rate in more than 70% of cases in the short term**. However, **recent controlled trials have not confirmed this optimistic view**, thus emphasizing the role of standard care.

Tariq[37] 2003

Fecal incontinence is an underreported problem in the general population; (…) **Treatment with biofeedback is feasible in many elderly patients**. Those with advanced dementia or physical disability may benefit from a bowel habit training program. Selected patients may require surgical sphincter repair. Minimally invasive techniques such as radiofrequency energy application offer promising future treatment options.

Hinninghofen[38] 2003

Fecal incontinence affects men and women of all ages, leading to personal disability and high financial costs. (…) Patient selection for suitable treatment is most important and should be based on clinical and physiologic findings. (…) **Biofeedback therapy is effective in most patients**. It has **no side effects and is well tolerated**. (…)

Kroesen[39] 2003

Biofeedback training is a well established method for the treatment of faecal incontinence. Prior to any biofeedback training program, a definitive diagnostic study is essential. Idiopathic faecal incontinence is the main indication for biofeedback training. Additional indications are a menacing faecal incontinence after deep anterior rectal excision with restoration of the rectal reservoir by an ileoanal pouch, anal sphincter reconstruction, rectopexy and rectocele repair. **Only four studies provide evidence-based medical criteria. These, as well as numerous uncontrolled studies, show the effectiveness of biofeedback training for the treatment of faecal incontinence**. Electrical stimulation of the anal sphincter is only shown to be effective in one controlled study in which it was combined with biofeedback training.

Rudolph[40] 2002

(…) **Management of fecal incontinence involves the use of** antidiarrheal medication and fiber products**, biofeedback**, or enemas. A qualified surgeon should be consulted during the course of the patient's evaluation, particularly when medical therapy is unsuccessful. Knowledge of the appropriate diagnosis, evaluation, and management of fecal incontinence may result in more patients seeking medical attention and thus improving their quality of life.

Norton[41] 2001

(…) AIM: To systematically review and evaluate the evidence from clinical studies on the effectiveness of biofeedback as a treatment for faecal incontinence in adults. METHODS: A systematic literature search was undertaken using electronic databases, with review of the retrieved references. RESULTS: The search identified 46 studies published in English using biofeedback to treat adults complaining of faecal incontinence. Those studies included a total of 1364 patients. Of those studies with adequate data, **275 out of 566 patients (49%) were said to be cured of symptoms of faecal incontinence following biofeedback therapy and 617 out of 861 (72%) patients were reported to be cured or improved**. Studies varied in the method of biofeedback used, criteria for success and the outcome measures used. **Only eight of the 46 studies employed any form of control group.** CONCLUSIONS: The **data suggest that biofeedback and exercises help a majority of patients with faecal incontinence. However, methodological variation, lack of controls and a lack of validated outcome measures are problems in evaluating these results**.

Norton[42] 2001

In a previous article we described a nursing assessment for adults with fecal incontinence. This article outlines in detail the program of care, tailored to an individual's assessed needs, that is available in the **nurse-led biofeedback service** for fecal incontinence at St Mark's Hospital in England. A recent evaluation of this program found that **two thirds of patients reported improved fecal continence**

after receiving care from this service.

Soffer[43] 2000

(…) **Biofeedback therapy is effective in the majority of patients** and is particularly attractive because it is safe and well tolerated. Surgery is offered when medical therapy is unsuccessful or when the etiology is thought to respond best to surgery, such as in postobstetric trauma. (…)

Norton[44] 2006 (Cochrane Review)

(…) OBJECTIVES: To determine the effects of biofeedback and/or anal sphincter exercises/pelvic floor muscle training for the treatment of faecal incontinence in adults. (…) MAIN RESULTS: Only five eligible studies were identified with a total of 109 participants. In the majority of trials **methodological quality was poor or uncertain**. All trials were small and employed a limited range of outcome measures. Follow-up information was not consistently reported amongst trials. Only two trials provided data in a form suitable for statistical analyses. **There are suggestions that rectal volume discrimination training improves continence more than sham training and that anal biofeedback combined with exercises and electrical stimulation provides more short-term benefits than vaginal biofeedback and exercises for women with obstetric-related faecal incontinence**. Further conclusions are not warranted from the available data. REVIEWER'S CONCLUSIONS: The limited number of identified trials together with their methodological weaknesses **do not allow a reliable assessment of the possible role of sphincter exercises and biofeedback therapy in the management of people with faecal incontinence.** There is a suggestions that some elements of **biofeedback therapy and sphincter exercises may have a therapeutic effect,** but this is not certain. Larger well-designed trials are needed to enable safe conclusions.

Hosker[45] 2000 (Cochrane review)

(…) OBJECTIVES: To determine the effects of electrical stimulation for the treatment of faecal incontinence in adults. (…) MAIN RESULTS: Only one eligible trial with 40 participants was identified. It was a randomised trial, but it suffered from **methodological drawbacks** and did not follow up patients beyond the end of the trial period. Findings from this trial **suggest that electrical stimulation with anal biofeedback and exercises provides more short-term benefits than vaginal biofeedback and exercises for women with obstetric-related faecal incontinence**. No further conclusions could be drawn from the data available. REVIEWER'S CONCLUSIONS: At present, there are **insufficient data to allow reliable conclusions** to be drawn on the effects of electrical stimulation in the management of faecal incontinence. (…)

Andrews[46] 2005

Fecal incontinence is a common symptom that often impairs quality of life. It is generally caused by a variety of conditions that are associated with anorectal

sensorimotor dysfunction and/or diarrhea. Assessment should be tailored to age and symptom severity. Modulation of disordered bowel habits is the key to management; **biofeedback and surgery might also be beneficial**.

Norton[47] 2004

Biofeedback has been advocated as first-line therapy for patients whose symptoms of mild to moderate fecal incontinence have not responded to simple dietary advice or medication. Three main modalities have been described: (1) use of an intra-anal electromyographic sensor, a probe to measure intra-anal pressure, or perianal surface electromyographic electrodes to teach the patient how to exercise the anal sphincter; (2) use of a 3-balloon system to train the patient to correctly identify the stimulus of rectal distention and to respond without delay; and (3) use of a rectal balloon to retrain the rectal sensory threshold, usually with the aim of enabling the patient to discriminate and respond to smaller rectal volumes. **Although a systematic review found that biofeedback eliminated symptoms in up to one half of patients and decreased symptoms in up to two thirds, these studies suffered from methodological problems, a lack of controls, and a lack of validated outcome measures**. (…)

Bassotti[48] 1997

Biofeedback, relaxation training, and cognitive behaviour modification are being increasingly proposed for the treatment of numerous functional disorders of the gastrointestinal tract. Among these, those related to the lower part of the gut seem to be more likely to benefit from this therapeutic approach. We examine and discuss the literature studies adopting such techniques.

Read[49] 1999

The aim of this chapter is to provide a clear and balanced account of the role of the various forms of psychotherapy in the irritable bowel syndrome (IBS). It commences with an account of the philosophical basis for psychotherapy, attempting to integrate the concepts of autonomic arousal, repression, conversion and a developmental disorder of thinking and emotional expression. **These concepts are used to explain why separation and loss can lead to the development of IBS and how the gut is such an important vehicle for emotional expression. Against this background the role and philosophy of relaxation therapy, hypnotherapy, biofeedback, cognitive behavioural therapy and analytical psychotherapy are discussed.** These therapies describe a philosophical approach that is quite different from biomedical treatments in that it attempts to harness the patient's own powers for recovery. **For that reason the efficacy of psychotherapies cannot be evaluated by randomized controlled trials**.

Palsson[50] 2004

This review aimed to critically evaluate the literature on the efficacy of biofeedback for functional anorectal disorders, rate these biofeedback applications according to

established guidelines, and make recommendations for this field based on the literature. The Medline and PsychInfo databases were searched to obtain all papers published from 1975 to 2003 that included the terms "biofeedback" and either "constipation" "pelvic floor dyssynergia" "fecal incontinence" or "anorectal pain." Adult and pediatric papers in any language were screened. Prospective studies with five or more participants and a description of the treatment protocol and outcome were selected for review. Seventy-four studies qualified for review: 33 trials on fecal incontinence (FI), 38 on pelvic floor dyssynergia (PFD) or functional constipation, and 3 on anorectal pain. Only 20% of studies were controlled outcome trials. Treatment protocols, etiological subgroups studied and outcome measures varied greatly. The overall average probability of successful treatment outcome for patients treated with biofeedback was 67.2% for functional FI and 62.4% for constipation. There were insufficient data to warrant such calculation for anorectal pain. **According to standard efficacy rating criteria, biofeedback treatment is efficacious for functional constipation or PFD in children and probably efficacious in adults; probably efficacious for functional FI; and possibly efficacious for anorectal pain.** Utilizing data from all applicable studies, we found that **success rate per subject is significantly higher for biofeedback treatment than for standard medical care for PFD/functional constipation, and FI ($p < .001$ for both). Biofeedback treatment may therefore be viewed as a valuable adjunct to medical management of functional PFD/constipation and incontinence.** A number of recommendations for future investigations are made based on the review.

9.1.1 Zusammenfassung Defäkationsstörungen

Die Aussagen in den verschiedenen Reviews reichen von *Biofeedback ist eine wirksame, einfache und nebenwirkungsfreie Therapie* (Jorge 2003, Stessman 2003, Sanmiguel 2003, Rao 1998, Chiarioni 2005, Hinninghofen 2003, Palsson 2004), *Biofeedback ist wirksam bei Erwachsenen* (Chiarioni 2006, Norton 2001, Soffer 2000), *Biofeedback ist eine mögliche Behandlung* (Remes-Troche 2006, Barlow 1997, Tariq 2003, Rudolph 2002, Norton 2001, Norton 2006, Andrews 2005, Norton 2004), *Biofeedback ist eine bereits eingesetzte Therapieform* (Rao 2003, Schiller 2001, Kroesen 2003, Bassotti 1997), *keine klare Aussage* (Wald 2007, Wafford 2000, Nurko 2000, Read 1999), *wenig qualitativ gute Studien* (Heymen 2003, Hosker 2000) bis zu *keine Evidenz über die Wirksamkeit von Biofeedback* (Brooks 2000, McGrath 2000, Brazzelli 2001, Norton 2000, Brazzelli 2006).

Es wird berichtet, dass die Studien mit positiver Aussage zumeist keine Kontrollgruppe haben, wobei hierzu Read 1999 die Unmöglichkeit der Evaluierung von Verhaltenstherapien in RCTs beschreibt.

Die Studien mit Kontrollgruppen können keine Wirksamkeit beweisen, wobei auch hier methodische Lücken beschrieben werden.

Es entsteht der Eindruck eines deutlichen psychologischen Zusammenhangs zwischen der Entwicklung von Defäkationsstörungen und der Möglichkeit ihrer

entsprechenden Behandlung. Dies kann auch ein Hinweis sein, warum Biofeedback bei Kindern nicht wirkt, jedoch bei Erwachsenen (Chiarioni 2006). Ein sehr individuelles Ansprechen und die Wichtigkeit der Motivation und Mitarbeit des Patienten scheinen hier von erhöhter Bedeutung zu sein und die Breite an Individualität zu erklären.

10 Schmerzen

10.1 Chronische Schmerzen

	Patienten	Outcome	Aussage der Studie
5: Flor H et al. Limitations of pharmacotherap...[PMID: 17087132]	Chronische Schmerzpatienten	Schmerzreduktion	Bei chronischen Schmerzen ist die Kombination von Verhaltens-therapien und Medikation wichtig, um Lernprozesse zu verändern.
140: Flor H. Cortical reorganisation and c...[PMID: 12817660]	Chronische Schmerzpatienten	Schmerzreduktion	Chronischer Schmerz kann durch Verhaltensänderung beeinflusst werden.
193: Nielson WR et al. Biopsychosocial approaches to...[PMID: 11783824]	Chronische Schmerzpatienten	Schmerzreduktion	Multimodale biopsychosoziale Behandlungen sind effektiv in der Behandlung von Low back pain und anderen Bewegungsschmerzen bis zu 12 Monaten.
199: Zermann DH et al. The male chronic pelvic pain ...[PMID: 11469604]	Chronische Schmerzpatienten mit Beckenschmerz	Schmerzreduktion	Nach genauer Abklärung der Schmerzursachen sollte eine Neuro-Verhaltensspezifische Sichtweise Anwendung finden.

Flor[51] 2007

Pharmacotherapy is most appropriate in acute pain, whereas **in chronic pain states behavioral approaches or a combination of behavioral treatment and pharmacotherapy is more appropriate**. In this chapter we first describe the role of learning and memory as well as other psychological factors in the development of chronic pain and emphasize that **chronic pain must viewed as the result of a learning process with resulting central neuroplastic changes**. We then describe operant behavioral and cognitive-behavioral treatments as well as biofeedback and relaxation techniques and present innovative treatment procedures aimed at altering central pain memories.

Flor[52] 2003

(…) Functional reorganisation in both the somatosensory and the motor system was observed in neuropathic and musculoskeletal pain. (…) These central alterations may be viewed as pain memories that influence the processing of both painful and nonpainful input to the somatosensory system as well as its effects on the motor system. **Cortical plasticity related to chronic pain can be modified by behavioural interventions that provide feedback to the brain areas that were altered by somatosensory pain memories or by pharmacological agents that prevent or reverse maladaptive memory formation.**

Nielson[53] 2001

(…) OBJECTIVE: This review sought to determine how effective unimodal and multimodal biopsychosocial approaches are in the treatment of chronic pain. (…) RESULTS: (…) Biopsychosocial components reviewed were electromyogram feedback and hypnosis as unimodal approaches, and behavioral and cognitive-behavioral treatments and back school, or group education, as multimodal approaches for chronic low back pain. For other chronic pain disorders, cognitive-behavioral treatments were reviewed. Comparisons were hindered by studies with heterogeneous subjects, varied comparison groups, different cointerventions and follow-up times, variable outcomes, and a range of analytic methods. CONCLUSIONS: **Multimodal biopsychosocial treatments that include cognitive-behavioral and/or behavioral components are effective for chronic low back pain and other musculoskeletal pain for up to 12 months (level 2). There is limited evidence (level 3) that electromyogram feedback is effective for chronic low back pain for up to 3 months. The remaining evidence of longer-term effectiveness and of effectiveness of other interventions was inadequate (level 4a) or contradictory (level 4b**). Future studies of cognitive-behavioral treatments should be condition specific, rather than include patients with different pain conditions.

Zermann[54] 2001

(…) Because we continue to struggle with chronic pelvic pain disorders both diagnostically and therapeutically, **a neuro-behavioral perspective should be used in an attempt to explain pathways and neurophysiological mechanisms**, and to improve diagnostics and treatment of male pelvic pain. **First, however, malignant and acute/chronic bacterial disease has to be excluded as a cause of chronic pain in every single case**. Then diagnostic approaches should screen for lower urinary tract dysfunction, pelvic floor functional disorders, and disturbed reflex integrity within the pelvic area. (…)

10.1.1 Zusammenfassung chronische Schmerzen

Die Entwicklung des Schmerzgedächtnisses als Lernprozess und die Veränderung desselben lassen die genannten Review-Autoren sehr einheitlich die Anwendung von Verhaltenstherapeutischen Maßnahmen (wie Biofeedback) empfehlen. Klare Evidenz (level 2) beschreibt Nielson 2001 für den Einsatz dieser Maßnahmen beim unteren Rückenschmerz.

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10.2 Kopfschmerz

	Patienten	Outcome	Aussage der Studie
11: Hershey AD et al. Chronic daily headaches in ch...[PMID: 16945254]	Kopfschmerzpatienten	Schmerzreduktion	Chronische Kopfschmerzen verlangen nach einem multidisziplinären Therapieansatz, inklusive Biofeedback für das Langzeitmanagement.
57: Powers SW et al. Biobehavioral treatment, disa...[PMID: 16018228]	Kopfschmerzpatienten	Schmerzreduktion	Biofeedback unterstützte Entspannung ist eine Grundlage für die Behandlung von chronischen Kopfschmerzen
63: Biondi DM. Noninvasive treatments for he...[PMID: 15938668]	Kopfschmerzpatienten	Schmerzreduktion	Physikalische Therapiemethoden des chronischen Kopfschmerzes sind am meisten effektiv in Kombination zB mit Biofeedback. Die Evidenzlage ist noch lückenhaft
160: Lipchik GL et al. Cognitive-behavioral issues i...[PMID: 12413406]	Kopfschmerzpatienten	Schmerzreduktion	Als first-line Therapie ist Biofeedback wenig erfolgreich, jedoch im Einsatz bei leichtem Schmerz zur Verhinderung der Chronifizierung
168: Penzien DB et al. Behavioral management of recu...[PMID: 12206049]	Kopfschmerzpatienten	Schmerzreduktion	Verhaltensinterventionen (wie Biofeedback) bringen 35-50% Besserung bei Kopfschmerzen und Migräne.
169: Hermann C et al. Biofeedback in the treatment ...[PMID: 12206048]	Kopfschmerzpatienten	Schmerzreduktion	Keine klare Aussage im Abstract
177: Solomon GD. Chronic tension-type headache...[PMID: 11990648]	Kopfschmerzpatienten	Schmerzreduktion	Die Therapie des chronischen Kopfschmerzes (3% Prävalenz) beinhaltet unter anderem Biofeedback, obwohl Studien mit hohem Level dazu noch fehlen.
186: Evers S et al. [Treatment of idiopathic head...[PMID: 11845341]	Kopfschmerzpatienten	Schmerzreduktion	First line Therapie für die nicht-medikamentöse Behandlung des kindlichen Kopfschmerzes ist unter anderen Biofeedback
232: Diamond S. Tension-type headache....[PMID: 10682186]	Kopfschmerzpatienten	Schmerzreduktion	Biofeedback kann hilfreich sein
278: Van Hook E. Non-pharmacological treatment...[PMID: 9523058]	Kopfschmerzpatienten	Schmerzreduktion	Biofeedback und Entspannungstraining helfen bei Kopfschmerz in Zusammenhang mit Befindlichkeitsstörungen

Hershey[55] 2006

Chronic daily headache (CDH) is increasingly recognized as a problem in pediatrics and tertiary pediatric headache care. It is estimated that up to 4% of the adult population has CDH. Many of these are chronic migraine (CM). (…) Evaluation of CDH needs to include a complete history and physical examination to identify any possibility of the secondary headaches or headaches directly attributed to a secondary cause. **Treatment and management involve a multidisciplinary approach, including acute therapy for when the headache severity increases** (while avoiding medication overuse), preventative therapy to reduce the frequency and impact of the CDH, **and biobehavioral therapy to assist with long-term outcome**.

Powers[56] 2005

Headache is a common condition among children and adolescents, and it can result in considerable pain, distress, and functional disability. (…) Biobehavioral treatments are central to *therapeutic* (Logical changed; Anm.) intervention. From promotion of adherence to optimal use of abortive and prophylactic medications to health behaviors **that reduce headache activity to biofeedback-assisted relaxation training**, the addition of biobehavioral treatment components to a comprehensive pediatric headache care plan can lead to better initial clinical outcomes, may lessen the need for medication, and may help maintain effects over the long term. (…) **Biobehavioral treatment is a foundation for provision of such care**.

Biondi[57] 2005

(…) A medical literature review was completed in order to gather information regarding the efficacy of selected physical modalities in the treatment of primary and cervicogenic headache disorders(…) **Physical therapy is most effective for the treatment of migraine when combined with other treatments such as thermal biofeedback,** relaxation training and exercise. (…) In general, **strong evidence is lacking regarding the efficacy of these treatments in reducing headache frequency**, intensity, duration and disability in many commonly encountered clinical situations. **Many of the published case series and controlled studies are of low quality**. (…)

Lipchick[58] 2002

Chronic daily headache is a heterogeneous group of daily or near-daily headaches that afflicts close to 5% of the general population and accounts for close to 35% to 40% of patients at headache centers. **First-line drug or cognitive-behavioral therapies administered alone have minimal impact on reducing the frequency or severity of headaches.** However, **combined drug and cognitive-behavioral therapy shows promise** in providing the most benefit for this often intractable condition. **Cognitive-behavioral therapies focus on preventing mild pain from becoming disabling pain**, improving headache-related disability, affective distress, and quality of life, and reducing overreliance on medication. For cognitive-behavioral

therapies to be effective, it is important to address complicating factors, including medication overuse, psychiatric comorbidity, stress and poor coping, and sleep disturbance.

Penzien[59] 2002

In the past three decades, **behavioral interventions (chiefly relaxation, biofeedback, and stress-management) have become standard components of** the armamentarium for **management of migraine** and tension-type headaches. Meta-analytic literature reviews of these behavioral interventions have consistently identified clinically significant reductions in recurrent headache. **Across studies, behavioral interventions have yielded approximately 35-50% reduction in migraine and tension-type headache activity**. (…) Select future directions are discussed, which include impact of the triptans, cost and cost effectiveness, and integration of behavioral treatments into primary care settings, the place where the great majority of headache sufferers receive treatment.

Hermann[60] 2002

Since the first biofeedback (BFB) studies on pediatric pain were published in the early 1980s, most of the studies have focused on the treatment of pediatric migraine. More recently, BFB has also been evaluated in the treatment of tension headache in children. Not surprisingly, most of what we know about the efficacy and mechanisms of BFB in the treatment of children's pain problems concerns the treatment of childhood headache (HA). In this review, we provide a detailed summary of studies that have evaluated BFB in the treatment of childhood HAs with an emphasis on treatment outcome and maintenance of treatment success. Moreover, findings and hypotheses with regard to the mechanisms that may mediate the treatment effects of BFB are addressed. Finally, we discuss specific issues relating to the treatment of pain in children with BFB and outline future directions of research.

Solomon[61] 2002

About 3% of people experience daily viselike headaches without other associated symptoms, a condition called chronic tension-type headache. Therapy consists of tricyclic antidepressants, **biofeedback**, and stress management, although compelling **data from randomized controlled trials are lacking**.

Evers[62] 2002

According to the principles of evidence-based medicine, the controlled studies on the treatment of idiopathic headache in childhood have been analysed and compiled to treatment recommendations. For the acute treatment of migraine attacks or tension-type headache, ibuprofen (10 mg per kg body weight) or acetaminophen (15 mg per kg body weight) are recommended with highest evidence, intranasal sumatriptan (10 to 20 mg) can be given as second choice. For the prophylaxis of migraine, betablockers (propranolol and metoprolol), flunarizine, and valproic acid are recommended. Flunarizine is the drug of first choice in the treatment of migraine-

related disorders. No controlled studies are available for the treatment of further headache types. **First line methods for the non-drug treatment of headache in childhood are relaxation therapies, biofeedback, and specific training schedules**.

Diamond[63] 1999

Tension-type headaches, the most prevalent form of headache, are differentiated as being either episodic or chronic. The episodic form is a physiologic response to stress, anxiety, depression, emotional conflicts, fatigue, or repressed hostility. (…) **In addition to nonhabituating drug therapies, family counseling and biofeedback may be helpful.** (…)

Van Hook[64] 1998

Headache and mood disorders co-occur at significant rates. **Two psychological techniques of proven effectiveness in treating headache are biofeedback and relaxation training.** For treating the mood disorders that accompany chronic headache, cognitive-behavioral and pharmacological therapies are highly effective both individually and combined. (…)

10.2.1 Zusammenfassung Kopfschmerz

Chronische Kopfschmerzen ohne erkennbare medizinische Ursache gehen häufig mit Befindlichkeitsstörungen einher, weshalb ein multidisziplinärer Therapieansatz (unter anderem mit Biofeedback) empfohlen wird (Hershey 2006, Powers 2005, Biondi 2005, Lipchick 2002, Solomon 2002, Van Hook 1998), die Evidenz dazu ist jedoch noch lückenhaft (Biondi 2005, Diamond 1999). Biofeedback ist als first line Therapie kontrovers beschrieben (Lipchick (2002) – wenig erfolgreich; Evers 2002 – erfolgreich bei Kindern). Penzien 2002 findet in den Studien eine Besserung des Kopfschmerzes durch Biofeedback in 35-50%.

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10.3 Migräne

	Patienten mit	Outcome	Aussage der Studie
65: Sandor PS et al. Nonpharmacologic treatment of...[PMID: 15907259]	Migräne	Anfallsreduktion	Evidenz zu Biofeedback bei Migräne ist alt
67: Andrasik F. Behavioral treatment of migra...[PMID: 15853538]	Migräne	Anfallsreduktion	Biofeedback, Entspannungstherapie und kognitive Therapie sind von beträchtlichem Wert, Verhaltenstherapien sind bei menstruell bedingter Migräne von gemischtem Erfolg
95: Niederberger U et al. [Non pharmacological treatmen...[PMID: 15300473]	Migräne	Anfallsreduktion	Die aktive Mitarbeit des Patienten ist bei allen nicht-medikamentösen Therapieansätze Voraussetzung. Langzeiteffekte ähnlich den medikamentösen Therapien
171: Baumann RJ. Behavioral treatment of migra...[PMID: 12175270]	Migräne	Anfallsreduktion	Biofeedback effektiv, physiologische Basis unklar
166: Kropp P et al. On the pathophysiology of mig...[PMID: 12206051]	Migräne	Anfallsreduktion	Biofeedback kann bei der Ursache der Migräne ansetzen – nämlich corticaler Überempfindlichkeit, Überaktivität und Gewöhnung
251: McGrath PJ. Clinical psychology issues in...[PMID: 10563231]	Migräne	Anfallsreduktion	Biofeedback ist erwiesen wirksam, bedarf jedoch der aktiven Mitarbeit des Patienten

Sandor[65] 2005

Nonpharmacologic treatment of migraine is often used by patients (…) Behavioral approaches, such as relaxation techniques, **biofeedback**, and cognitive-behavioral therapy, require far more specialist time or technical devices, but **are supported by some evidence, which is mostly old**. (…) More studies on the different therapeutic interventions are needed, using modern diagnostic standards and state-of-the-art trial methodology.

Andrasik[66] 2004

The empirical support for three behavioral treatments (**relaxation, biofeedback and cognitive therapy**) for managing migraine headaches in children and adults is reviewed. **Meta-analyses and evidence-based reports show that these approaches are of considerable value, they appear to work equally well when applied individually, in groups or in limited contact formats.** Meta-analyses comparing behavioral and prophylactic medication show equivalent results. However, outcomes are optimized when these treatments are combined. Researchers are currently seeking to identify factors predictive of response to behavioral approaches. Patients experiencing medication-overuse, refractory, cluster or post-traumatic forms of headache or comorbid conditions present special challenges that can require intensive, comprehensive and multidisciplinary approaches to treatment. **Behavioral treatments have met with mixed success for menstrual migraine** in the few studies that have been conducted. (…)

Niederberger[67] 2004

Actual recommendations for treatment of migraine consist both of pharmacological and non-pharmacological treatment. The latter enables the patient higher responsibility and self-efficacy in coping with migraine. Therefore, **the active involvement in the treatment of the patients is obligatory in all psychological pain therapy methods**. Focus of therapy are emotional, cognitive, behavioural and social factors of migraine illness, with the aim to modify unfavourable habits and migraine attack-inducing factors. **As non-pharmacological methods counselling, relaxation training, biofeedback and cognitive-behavioural treatments are employed**. The **long-term effects are comparable with those of pharmacological treatment**, combination of pharmacological and non-pharmacological treatment lead to even higher efficacy and is often indicated. (…)

Baumann[68] 2002

Behavioral interventions, particularly **biofeedback** and relaxation therapy, have **demonstrated their effectiveness in the treatment of both adults and older children with migraine in controlled trials**. The **physiological basis** for their effectiveness is **unclear**, but data from one trial suggest that levels of plasma beta-endorphin can be altered by relaxation and biofeedback therapies. (…) Biofeedback therapies commonly use an apparatus to demonstrate a physiological effect. Most commonly in pediatrics, children are taught to raise the temperature of one of their

fingers. This can be done with or without a thermometer. **Several groups have shown that these techniques can be taught to children and that their use is associated with fewer and briefer migraine headaches**. (…)

Kropp[69] 2002

Psychophysiological data support the concept that **migraine is the result of cortical hypersensitivity, hyperactivity, and a lack of habituation**. There is evidence that this is a brain-stem related information processing dysfunction. This cortical activity reflects a periodicity between 2 migraine attacks and it may be due to endogenous or exogenous factors. In the few days preceding the next attack slow cortical potentials are highest and habituation delay experimentally recorded during contingent negative variation is at a maximum. These striking features of slow cortical potentials are predictors of the next attack. The pronounced negativity can be fed back to the patient. The data support the hypothesis that a change in amplitudes of slow cortical potentials is caused by altered habituation during the recording session. This kind of neurofeedback can be characterized as "empirically based" because it improves habituation and it proves to be clinically efficient.

McGrath[70] 1999

(…) Psychological treatments especially relaxation training and **biofeedback have been well validated as effective in treating frequent migraine**. When the frequency and severity of migraine warrants more than analgesics, these treatments are the first line treatment for adults who cannot or do not wish to take abortive or prophylactic medications and for adolescents. The use of psychological interventions to enhance compliance to treatment or treatment effects is an underutilized resource. Psychological measurement is also critical in development and understanding of quality of life scales and the examination of decision-making by patients in taking medication. (…)

10.3.1 Zusammenfassung Migräne

Biofeedback ist in der Behandlung der Migräne (Reduktion der Anfallshäufigkeit) wertvoll (Andrasik 2004, Kropp 2002) und effektiv (Baumann 2002, McGrath 1999), setzt jedoch die aktive Mitarbeit des Patienten voraus (Niederberger 2004, McGrath 1999).

Kropp 2002 sieht in der Behandlung mit Neurofeedback die Ursache der Migräne behandelt (durch Feedback falsch erlernter Mechanismen und Umgewöhnung).

Sandor 2005 sieht Biofeedback zurückhaltend und spricht von „alter Evidenz“ dazu.

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10.4 Andere Schmerzzustände

	Patienten mit	Outcome	Studienaussage
96: Huntley AL et al. Complementary and alternative...[PMID: 15295342]	Wehenschmerz	Schmerzreduktion	Insuffiziente Evidenz zur Wirksamkeit von Biofeedback bei Wehenschmerz
129: Victor L et al. Psychosocial therapies for ne...[PMID: 12948346]	Genickschmerzen	Schmerzreduktion	Biopsychologische Ansätze erlauben dem Patienten Schmerzen zu verstehen und zu kontrollieren
206: Haythornthwaite JA et al. Psychological assessment and ...[PMID: 11252146]	Neuropathischem Schmerz	Schmerzreduktion	Biofeedback wird als erfolgreich berichtet
223: Rusy LM et al. Complementary therapies for a...[PMID: 10835992]	Schmerz Management bei Kindern	Schmerzreduktion	Biofeedback kann das Management bei Kindern mit Schmerzen verbessern.
2: Myers CD. Complementary and alternative...[PMID: 17185070]	Gesichtsschmerz	Schmerzreduktion	Komplementäre Therapiemethoden klingen vielversprechend, es sind aber noch viele Fragen unbeantwortet
167: Middaugh SJ et al. Biofeedback and behavioral tr...[PMID: 12206050]	Ältere Patienten mit Dauerschmerz	Schmerzreduktion	Ältere Patienten profitieren von kombinierten Schmerztherapien mit z.B. Biofeedback
173: Anderson RU. Management of chronic prostat...[PMID: 12109351]	chronisches Beckenschmerzsyndrom bei Prostatitis	Schmerzreduktion	Elekro-Neuromodulations-Techniken scheinen vielversprechend
155: Weydert JA et al. Systematic review of treatmen...[PMID: 12509588]	Kinder mit wiederkehrendem Bauchschmerz	Schmerzreduktion	Es existiert Evidenz für die Wirksamkeit von Biofeedback bei Kindern mit Bauchschmerzen
56: Rosenbaum TY. Physiotherapy treatment of se...[PMID: 16020150]	Sexuellen Schmerzstörungen	Schmerzreduktion	Keine klare Aussage

Huntley[71] 2004

OBJECTIVES: The purpose of this study was to systematically review the literature for, and critically appraise, randomized controlled trials of any type of complementary and alternative therapies for labor pain. STUDY DESIGN: Six electronic databases were searched from their inception until July 2003. The inclusion criteria were that they were prospective, randomized controlled trials, involved healthy pregnant women at term, and contained outcome measures of labor pain. RESULTS: Our search strategy found 18 trials. Six of these did not meet our inclusion criteria. The remaining 12 trials involved acupuncture (2), **biofeedback** (1), hypnosis (2), intracutaneous sterile water injections (4), massage (2), and respiratory autogenic training (1). CONCLUSION: **There is insufficient evidence for the efficacy of any of the complementary and alternative therapies for labor pain, with the exception of intracutaneous sterile water injections**. For all the other treatments described it is **impossible to make any definitive conclusions** regarding effectiveness in labor pain control.

Victor[72] 2003

The biopsychosocial approach provides the necessary framework for understanding and treating chronic pain. Through education, cognitive-behavioral therapy, relaxation training, and active adaptation, the **biopsychosocial approach allows patients to learn to control their internal environments** (pain-related thoughts and emotions) and to influence their responses to the external environment (physical condition, work, significant others, and other stresses). This education-based model of therapy combines naturally with the medical model and medical care.

Haythornthwaite[73] 2001

Studies on the psychological assessment and treatment of neuropathic pain conditions, including postherpetic neuralgia (PHN), diabetic neuropathy, complex regional pain syndrome, post spinal cord injury, post amputation, and AIDS-related neuropathy, are reviewed. Although limited information is currently available, the findings are consistent with the larger literature on chronic pain and indicate that the assessment of neuropathic pain needs to include measurement of multiple dimensions of quality of life. **Mood, physical and social functioning, and pain-coping strategies such as catastrophizing and social support are all important domains. Clinical trials of psychological interventions have not been reported in the scientific literature.** Case series of **successful treatment of neuropathic pain are reported, primarily in the area of biofeedback**. As with other chronically painful conditions, it is likely that cognitive-behavioral interventions will improve the quality of life in neuropathic pain conditions.

Rusy[74] 2000

A wide variety of tools to adequately treat pediatric pain is beneficial. The methods discussed herein typically involve the use of many areas of expertise to manage pain. Massage therapists, **biofeedback** technicians, physician-acupuncturists, child-

life specialists, psychologists, and physical or occupational therapists **can** all **be used as allies to battle acute pain in children.** The incorporation of alternative forms of pain management, including education, relaxation techniques, hypnosis, guided imagery, biofeedback, and even acupuncture, to the standard methods **may improve the management** of children with acute pain. The management of children with pain does not have to be with an "either/or" approach using traditional pharmacologic methods or the cognitive and alternative therapies discussed here. Many areas **need research to provide evidence** that these therapies work well. (…)

Myers[75] 2007

This article discusses complementary and alternative medicine (CAM), reviews literature on the prevalence of use of CAM by the general adult population in the United States and by patients with persistent facial pain, and summarizes published, peer-reviewed reports of clinical trials assessing the effects of CAM therapies for persistent facial pain. Results indicate that many patients use CAM for musculoskeletal pain, including persistent facial pain. **Preliminary work on selected complementary therapies such as biofeedback, relaxation, and acupuncture seems promising; however, there are more unanswered than answered questions about cost-effectiveness, efficacy and mechanisms** of action of CAM for persistent facial pain.

Middaugh[76] 2002

(…) A review of the literature indicates that older adults develop multiple pain-related problems that are similar to those of younger individuals. When offered the opportunity, **older pain patients accept and benefit from multidisciplinary pain programs, cognitive-behavioral therapies and biofeedback training**. A study comparing 58 older and 59 younger adults in a multidisciplinary pain program indicates that older pain patients readily acquire the physiological self-regulation skills taught in biofeedback-assisted relaxation training, and achieve comparable decreases in pain for the pain program as a whole.

Anderson[77] 2002

Although the **neurobiologic basis** of CPPSs (chronic prostatitis-chronic pelvic pain syndrome) in men **remains unclear**, therapeutic interventions should continue to be improved. Invasive or destructive modalities should be avoided when possible. **Electrical neuromodulation techniques seem to be a promising, among other multimodal approaches**. Physicians must learn from patients in attempt to relieve symptoms.

Weydert[78] 2003

OBJECTIVE: To conduct a systematic review of evaluated treatments for recurrent abdominal pain (RAP) in children. (…) RESULTS: **Studies that evaluated** famotidine, pizotifen, cognitive-behavioral therapy, **biofeedback**, and peppermint oil enteric-coated capsules **showed a decrease in measured pain outcomes** for those

who received the interventions when compared with others in control groups. (…) CONCLUSIONS: **Evidence for efficacy of treatment of RAP in children was found for** therapies that used famotidine, pizotifen, cognitive-behavioral therapy, **biofeedback**, and peppermint oil enteric-coated capsules. (…)

Rosenbaum[79] 2005

Physiotherapists provide treatment to restore function, improve mobility, relieve pain, and prevent or limit permanent physical disabilities of patients suffering from injuries or disease. Women with vulvar pain, dyspareunia, or vaginismus have limited ability to function sexually and often present with musculoskeletal and neurological findings appropriately addressed by a trained physiotherapist. **Although pelvic floor surface electromyography (sEMG) biofeedback has been studied**, the inclusion of physiotherapy in the team approach to treating women with sexual pain disorders is a relatively recent advancement, and **its exact role is not widely understood by doctors**, mental health professionals, or laypersons. (…)

10.4.1 Zusammenfassung andere Schmerzzustände

Für den Einsatz Biofeedback bei Wehenschmerzen existiert keine Evidenz (Huntley 2004), in der Behandlung von Genickschmerzen besteht durch Biofeed die Möglichkeit der Schmerzkontrolle (Viktor 2003), Biofeedback ist erfolgreich bei neuropathischem Schmerz (Haythornwaite 2001) und im Schmerzmanagement bei Kindern (Rusy 2000), und scheint vielversprechend im Einsatz bei Gesichtsschmerz (Myers 2007), bei älteren chronischen Schmerzpatienten (Middaugh 2002) und bei Beckenschmerz aufgrund Prostatitis (Anderson 2002).

Weydert (2003) berichtet Evidenz für Biofeedback bei Kindern mit wiederkehrenden Bauchschmerzen, zum Einsatz bei sexuellen Schmerzzuständen gibt es keine klare Aussage (Rosenbaum 2005).

11 Neurologische Erkrankungen

	Patienten	Outcome	Biofeedback Studien
27: Sterman MB et al. Foundation and practice of ne...[PMID: 16614940]	Patienten mit Epilepsie	Reduktion der Anfallshäufigkeit	Neurofeedback Behandlung ist eine gut fundierte Alternative in der Behandlung der Epilepsie
47: Ramaratnam S et al. Psychological treatments for ...[PMID: 16235293]	Patienten mit Epilepsie	Reduktion der Anfallshäufigkeit	Keine fundierte Evidenz für Biofeedback bei Epilepsie
51: Sheth RD et al. Nonpharmacological treatment ...[PMID: 16114176]	Kinder mit Epilepsie	Reduktion der Anfallshäufigkeit	Obwohl die Mechanismen nicht ausreichend erforscht sind, bieten Methoden wie Biofeedback wichtige Zusatzoptionen im Management dieser Patienten
80: Walker JE et al. Neurofeedback treatment of ep...[PMID: 15564057]	Patienten mit Epilepsie	Reduktion der Anfallshäufigkeit	Mit EEG Biofeedback kann die Anfallshäufigkeit reduziert werden
276: Lubar JF. Electroencephalographic biofe...[PMID: 9737738]	Patienten mit Epilepsie	Reduktion der Anfallshäufigkeit	Biofeedback kann zu Verhaltensänderung, Kontrolle kardialer Arrythmien und Bluthochdruck, Muskeltraining und gegen Kopfschmerz genutzt werden

Sterman[80] 2006

This review provides an updated overview of the neurophysiological rationale, basic and clinical research literature, and current methods of practice pertaining to clinical neurofeedback. It is based on documented findings, rational theory, and the research and clinical experience of the authors. While considering general issues of physiology, learning principles, and methodology, it focuses on the treatment of epilepsy with sensorimotor rhythm (SMR) training, arguably the best established clinical application of EEG operant conditioning. **The basic research literature provides ample data to support a very detailed model of the neural generation of SMR, as well as the most likely candidate mechanism underlying its efficacy in clinical treatment. Further, while more controlled clinical trials would be desirable, a respectable literature supports the clinical utility of this alternative treatment for epilepsy**. However, the skilled practice of clinical neurofeedback requires a solid understanding of the neurophysiology underlying EEG oscillation, operant learning principles and mechanisms, as well as an in-depth appreciation of the ins and outs of the various hardware/software equipment options open to the practitioner. **It is suggested that the best clinical practice includes the systematic mapping of quantitative multi-electrode EEG measures against a normative database before and after treatment to guide the choice of treatment strategy and document progress towards EEG normalization**. We conclude that the research literature reviewed in this article justifies the assertion that

neurofeedback treatment of epilepsy/seizure disorders constitutes a well-founded and viable alternative to anticonvulsant pharmacotherapy.

Ramaratnam[81] 2005 (Cochrane Review)

(…) OBJECTIVES: To assess whether the treatment of epilepsy with psychological methods is effective in reducing seizure frequency and/or leads to a better quality of life. (…) MAIN RESULTS: We found three small trials (50 participants) of relaxation therapy. They were of poor methodological quality and a meta-analysis was therefore not undertaken. No study found a significant effect of relaxation therapy on seizure frequency. One trial found cognitive behavioural therapy to be effective in reducing depression, among people with epilepsy with a depressed affect, whilst another did not.One trial of group cognitive therapy found no significant effect on seizure frequency. **Two trials of combined relaxation and behaviour therapy and one of EEG bio-feedback and four of educational interventions did not provide sufficient information to assess their effect on seizure frequency**. One small study of galvanic skin response biofeedback reported significant reduction in seizure frequency. Combined use of relaxation and behaviour modification was found beneficial for anxiety and adjustment in one study. **In one study EEG bio-feedback was found to improve the cognitive and motor functions in individuals with greatest seizure reduction**. Educational interventions were found to be beneficial in improving the knowledge and understanding of epilepsy, coping with epilepsy, compliance to medication and social competencies. AUTHORS' CONCLUSIONS: **In view of methodological deficiencies and limited number of individuals studied, we have found no reliable evidence to support the use of these treatments and further trials are needed.**

Sheth[82] 2005

Approximately one third of children with epilepsy have persistent seizures despite trials of multiple antiepileptic medications. For some of these patients, epilepsy surgery may provide freedom from seizures. However, in many cases, epilepsy surgery is not a viable treatment option. Nonpharmacological approaches are a useful adjunct to help manage seizures in these children. This review examines the role of vagus nerve stimulation, the ketogenic diet, and various forms of EEG biofeedback therapy in children with intractable epilepsy. **Although the mechanism of action is not known precisely for any of these adjunctive therapies, they add an important and evolving dimension to the management of difficult to control epilepsy in children.** In addition, pyridoxine-dependent seizures are discussed as an example of an etiology of refractory seizures that responds well to replacement therapy.

Walker[83] 2005

With electroencephalographic (EEG) biofeedback (or neurofeedback), it is possible to train the brain to de-emphasize rhythms that lead to generation and propagation of seizure and emphasize rhythms that make seizures less likely to occur. **With recent**

improvements in quantitative EEG measurement and improved neurofeedback protocols, it has become possible in clinical practice to eliminate seizures or reduce the amount of medication required to control them. In this article, the history of neurofeedback for epilepsy is presented followed by discussions of the relevant neurophysiology of epilepsy. A model of how neurofeedback might raise the seizure threshold is then presented. Clinical experience using a quantitative EEG-guided approach is described, including a representative case study.

Lubar[84] 1998

Currently considerable research is being directed toward developing methodologies for controlling internal processes. An applied branch of the basic field of psychophysiology, known as biofeedback, has developed to fulfill clinical needs related to such control. **Current scientific and popular literature abounds with numerous examples of how biofeedback is being used**. For example, germinal studies by Kamiya (1962), and later work by Lynch and Paskewitz (1971), Beatty (1973), as well as many others have shown that the EEG alpha rhythm (8 to 13 Hz) recorded from occipital regions of the human brain can be **behaviorally manipulated** when feedback or reward is provided for changing the density of this activity. Other researchers have provided evidence that theta activity (4 to 7 Hz) and the beta activity (greater than 14 Hz) can also be controlled by humans and analogs of this activity have been conditioned in animals as well (Green, Green and Walters, 1971). In addition to the work that has been carried out with the EEG, researchers such as Engle and Bleecker (1973) have indicated that it might be possible to control **cardiac arrhythmias** through biofeedback. Studies by Elder et al. (1973) have provided some hope that **blood pressure** in humans might also be conditioned. Also, considerable effort has been directed to the control of responses from single muscles with particular applied emphasis in neuromuscular rehabilitation, control of **muscle tension for tension headaches** and the management of migraine headaches through vasomotor conditioning (Brudny et al., 1974; Basmajian, 1963, 1971; Sargent et al., 1973).

11.1.1 Zusammenfassung Neuro-Biofeedback

Ramaratnam 2005 (Cochrane Review und Update von 2003 und 2001) findet keine fundierte wissenschaftliche Evidenz für den Einsatz von Biofeedback bei Epilepsie. Als positiv im Einsatz zur Anfallsreduktion bei Epilepsie wird Biofeedback von Sterman 2006, Sheth 2005 und Walker 2005 berichtet. Lubar 1998 beschreibt Biofeedback als vorteilhaft im Einsatz gegen Verhaltensstörungen, kardiale Arrythmie, Bluthochdruck und Kopfschmerz sowie in der Neurorehabilitation.

12 Psychische Störungen

	Patient	Outcome	Studienaussage
83: Hammond DC. Neurofeedback with anxiety an...[PMID: 15564054]	Patienten mit Angststörungen	Besserung	Neurobiofeedback scheint wirksam und hat keine Nebenwirkungen
243: Moore NC. A review of EEG biofeedback t...[PMID: 10638346]	Patienten mit Angststörungen	Besserung	Alpha, theta and alpha-theta Steigerungen sind wirksame Therapiemethoden gegen Angststörungen, Behandlungsdauer, Krankheitsschwere und Vergleichstherapien benötigen weitere Studien
247: Basmajian JV. The third therapeutic revolut...[PMID: 10575538]	Patienten mit Verhaltensstörungen	Besserung	Effekte von Verhaltenstherapien und Biofeedback resultieren aus dem Placeboeffekt, aber Glaube an die Therapie spielt eine große Rolle für deren Erfolg
244: Morin CM et al. Nonpharmacologic treatment of...[PMID: 10617176]	Patienten mit chronischen Schlafstörungen	Besserung	Biofeedback entspricht den Kriterien der American Psychological Association (APA) für empirisch unterstützte psychologische Behandlungen der Schlaflosigkeit
151: Moss D. The circle of the soul: the r...[PMID: 12557456]	Patienten mit seelischen Schwierigkeiten	Besserung	Biofeedback und Neurofeedback können Entspannung, geistige Ruhe und das Auftreten spiritueller Erfahrungen fördern, überhaupt scheint Religion ein wichtiger therapeutischer Faktor
86: Hirshberg LM et al. Emerging brain-based interven...[PMID: 15564050]	Kinder mit Aufmerksamkeitsdefizit-Hyperaktivitätssysndrom (ADHD)	Besserung	Biofeedback entspricht den Guideline Kriterien der American Academy of Child and Adolescent Psychiatry for attention deficit hyperactivity disorder (ADHD) in der Behandlung von ADHD, Epilepsie, Angststörungen, Depression und nach Schädel-Hirn-Trauma
241: Nash JK. Treatment of attention defici...[PMID: 10638350]	Kinder mit ADHD	Besserung	Biofeedback eröffnet eine wirksame Therapiealternative für Patienten mit ADHD, deren medikamentöse Therapie durch Nebeneffekte eingeschränkt ist
25: Holtmann M et al. Electroencephalographic biofe...[PMID: 16623652]	Kinder mit ADHD	Besserung	Biofeedback klingt vielversprechend in der Behandlung des ADHD, es fehlen aber noch methodisch gute Studien
39: Fox DJ et al. Neurofeedback: an alternative...[PMID: 16385424]	Kinder mit ADHD	Besserung	Keine klare Aussage im Abstract
53: Loo SK et al. Clinical utility of	Kinder mit ADHD	Besserung	Im Abstract wird kontroverse Diskussion zu EEG Feedback angekündigt

EEG in at...[PMID: 16083395]			
59: Monastra VJ et al. Electroencephalographic biofe...[PMID: 16013783]	Kinder mit ADHD	Besserung	Biofeedback ist möglicherweise effektiv bei ADHD, aber es fehlen kontrollierte Studien
61: Rojas NL et al. Old and new controversies in ...[PMID: 15977318]	Kinder mit ADHD	Besserung	Es besteht der Bedarf an mehr methodisch hochwertigen Studien
72: Butnik SM. Neurofeedback in adolescents ...[PMID: 15723361]	Kinder mit ADHD	Besserung	Outcome nach Neurofeedback ist dem nach Medikationstherapie überlegen in der Behandlung von ADHD
85: Monastra VJ. Electroencephalographic biofe...[PMID: 15564052]	Kinder mit ADHD	Besserung	Biofeedback ist möglicherweise effektiv bei ADHD, aber es fehlen kontrollierte Studien
92: Holtmann M et al. [Neurofeedback for the treatm...[PMID: 15357015]	Kinder mit ADHD	Besserung	Biofeedback klingt vielversprechend in der Behandlung des ADHD, es fehlen aber noch methodisch gute Studien
101: Rossiter T. The effectiveness of neurofee...[PMID: 15208973]	Kinder mit ADHD	Besserung	Appell an einheitlich klare Studienmethodik zur Erforschung von Neurofeedback bei ADHD
109: Doggett AM. ADHD and drug therapy: is it ...[PMID: 15090116]	Kinder mit ADHD	Besserung	Keine klare Aussage im Abstract
190: Brue AW et al. Alternative treatments for at...[PMID: 11795624]	Kinder mit ADHD	Besserung	Keine Klarheit über die Wirkung alternativer Therapiemethoden
200: Ramirez PM et al. EEG biofeedback treatment of ...[PMID: 11462752]	Kinder mit ADHD	Besserung	EEG Biofeedback scheint vielversprechend, auch hinsichtlich der Methodik der Studien, dennoch wäre höhere methodische Qualität der Studien wünschenswert
159: Mamtani R et al. A primer of complementary and...[PMID: 12418362]	Patienten mit psychischen Störungen	Besserung	Viele kontrollierte Studien zeigen vielversprechende Resultate für Biofeedback bei Schmerz, Schlaflosigkeit und Angststörungen
248: Wickramasekera I. How does biofeedback reduce c...[PMID: 10575537]	Patienten mit seelischen Schwierigkeiten	Besserung	Effekt des Biofeedback ist höher, wenn Arzt und Patient daran glauben. Patienten mit geringer Hypnosefähigkeit sprechen auf Biofeedback besser an, Patienten mit hoher Hypnosefähigkeit auf autogenes Training u.ä.
17: Cortoos A et al.	Patienten mit	Besserung	Biofeedback könnte eine vielversprechende Therapiemodalität sein

Neurophysiological aspects of...[PMID: 16807007]	Schlaflosigkeit		
44: Weiskopf N et al. Self-regulation of local brai...[PMID: 16289548]	Selbstkontrolle für die eigenen Gehirnaktivität		Biofeedback ist brauchbar und ermöglicht die Selbstkontrolle der Hirnaktivität
220: Blakemore SJ et al. Why can't you tickle yourself...[PMID: 10943682]	Selbstkontrolle für die eigenen Gehirnaktivität		Eine Funktionserklärung des Neurofeedback summiert den positiven Einsatz bei akkustischen Halluzinationen oder Passiverfahrungen durch Umtrainieren des Kleinhirns.
18: Lincoln M et al. Altered auditory feedback and...[PMID: 16750562]	Kinder, die stottern	Besserung	Derzeit gibt es keinen Grund auditives feedback als vertretbare Therapie bei stotternden Kindern zu empfehlen

Hammond[85] 2005

A robust body of neurophysiologic research is reviewed on functional brain abnormalities associated with depression, anxiety, and obsessive-compulsive disorder. A review of more recent research finds that pharmacologic treatment may not be as effective as previously believed. A more recent neuroscience technology, electroencephalographic (EEG) **biofeedback (neurofeedback), seems to hold promise as a methodology for retraining abnormal brain wave patterns. It has been associated with minimal side effects and is less invasive than other methods for addressing biologic brain disorders.** Literature is reviewed on the use of neurofeedback with anxiety disorders, including posttraumatic stress disorder and obsessive-compulsive disorder, and with depression. Case examples are provided.

Moore[86] 2000

Alpha, theta and alpha-theta enhancements are effective treatments of the anxiety disorders. Alpha suppression is also effective, but less so. Perceived success in carrying out the task plays an important role in clinical improvement. Research is needed to find out how much more effective they are than placebo, and which variables are important for efficacy. **Variables needing study are: duration of treatment, type and severity of anxiety, number and type of EEG waveforms used, pretreatment with other kinds of feedback, position and number of electrodes, and presence of concomitant medication.**

Basmajian[87] 1999

Behavioral medicine--and one of its progenitors, **biofeedback**--are expanding as the **Third Therapeutic Revolution**, supplementing surgery and pharmacology in treating human illnesses. Parallel development of nonscience-based therapies is a part of the same revolution. Labeling their positive results as "placebo effects" hides a greater truth: **faith and trust play an enormous role in therapy**. The successes of both behavioral medicine and unorthodox complementary medicine are the result of the debonafide effect (my Latin for "from good faith"). (…)

Morin[88] 1999

This paper reviews the evidence regarding the efficacy of nonpharmacological treatments for primary chronic insomnia. It is based on a review of 48 clinical trials and two meta-analyses conducted by a task force appointed by the American Academy of Sleep Medicine to develop practice parameters on non-drug therapies for the clinical management of insomnia. The findings indicate that nonpharmacological therapies produce reliable and durable changes in several sleep parameters of chronic insomnia sufferers. The data indicate that between 70% and 80% of patients treated with nonpharmacological interventions benefit from treatment. For the typical patient with persistent primary insomnia, treatment is likely to reduce the main target symptoms of sleep onset latency and/or wake time after sleep onset below or near the 30-min criterion initially used to define insomnia

severity. Sleep duration is also increased by a modest 30 minutes and sleep quality and patient's satisfaction with sleep patterns are significantly enhanced. Sleep improvements achieved with these behavioral interventions are sustained for at least 6 months after treatment completion. However, there is no clear evidence that improved sleep leads to meaningful changes in daytime well-being or performance. **Three treatments meet the American Psychological Association (APA) criteria for empirically-supported psychological treatments for insomnia: Stimulus control, progressive muscle relaxation, and paradoxical intention; and three additional treatments meet APA criteria for probably efficacious treatments: Sleep restriction, biofeedback, and multifaceted cognitive-behavior therapy**. Additional outcome research is needed to examine the effectiveness of treatment when it is implemented in clinical settings (primary care, family practice), by non-sleep specialists, and with insomnia patients presenting medical or psychiatric comorbidity.

Moss[89] 2002

This paper examines the critical attitude of behavioral professionals toward spiritual phenomena, and the current growing openness toward a scientific study of spirituality and its effects on health. Health care professionals work amidst sickness and suffering, and become immersed in the struggles of suffering persons for meaning and spiritual direction. **Biofeedback and neurofeedback training can facilitate relaxation, mental stillness, and the emergence of spiritual experiences**. A growing body of empirical studies documents largely positive effects of religious involvement on health. The effects of religion and spirituality on health are diverse, ranging from such tangible and easily understood phenomena as a reduction of health-risk behaviors in church-goers, to more elusive phenomena such as the distant effects of prayer on health and physiology. Psychophysiological methods may prove useful in identifying specific physiological mechanisms mediating such effects. Spirituality is also a dimension in much of complementary and alternative medicine (CAM), and the CAM arena may offer a window of opportunity for biofeedback practice.

Hirshberg[90] 2005

Electroencephalogram biofeedback (EBF), repetitive transcranial magnetic stimulation (rTMS), and vagal nerve stimulation (VNS) are emerging interventions that attempt to directly impact brain function through neurostimulation and neurofeedback mechanisms. This article provides a brief overview of each of these techniques, summarizes the relevant research findings, and examines the implications of this research for practice standards based on the guidelines for recommending evidence based treatments as developed by the American Academy of Child and Adolescent Psychiatry for attention deficit hyperactivity disorder (ADHD). **EBF meets the "Clinical Guidelines" standard for ADHD, seizure disorders, anxiety, depression, and traumatic brain injury.** VNS meets this same standard for treatment of refractory epilepsy and meets the lower "Options" standard for several other disorders. rTMS meets the standard for "Clinical Guidelines" for bipolar

disorder, unipolar disorder, and schizophrenia. Several conditions are discussed regarding the use of evidence based thinking related to these emerging interventions and future directions.

Nash[91] 2000

Significant public health concerns exist regarding our current level of success in treating ADHD. Medication management is very helpful in 60-70% of patients. Side effects, lack of compliance and the fact that stimulant medications cannot be given late in the day limit the benefits largely to school hours. While stimulants improve behavior and attention, less of an effect has been noted on academic and social performance. Continuing concerns exist about long-term safety, and studies on long-term cardiovascular and neurophysiological effects have not been carried out. **Neurotherapy for ADHD offers an effective alternate for patients whose treatment is limited by side effects, poor medication response and in cases in which the patients and/or their parents refuse to consider medications. Studies indicate clinical improvement is largely related to measurable improvements in the EEG signature, evidenced by declining theta/beta ratios over frontal/central cortex and/or reduced theta/alpha band amplitudes.**

Holtmann[92] 2006 (updated 2004[93])

Considerable scientific effort has been directed at developing effective treatments for attention-deficit hyperactivity disorder (ADHD). Among alternative treatment approaches, **electroencephalographic (EEG) biofeedback has gained promising empirical support** in recent years. Short-term effects were shown to be comparable to those of stimulant medication at the behavioral and neuropsychological level, leading to significant decreases of inattention, hyperactivity and impulsivity. In addition, EEG biofeedback results in concomitant improvement of neurophysiological patterns. EEG biofeedback may already be used within a multimodal setting, providing affected children and adolescents with a means of learning to counterbalance their ADHD symptoms without side effects. **However, there is still a strong need for more empirically and methodologically sound evaluation studies.**

Fox[94] 2005

Current research has shown that neurofeedback, or EEG biofeedback as it is sometimes called, is a viable alternative treatment for Attention Deficit Hyperactivity Disorder (ADHD). **The aim of this article is to illustrate current treatment modalities(s), compare them to neurofeedback, and present the benefits of utilizing this method of treatment to control and potentially alleviate the symptoms of ADHD**. In addition, this article examines the prevalence rates and possible etiology of ADHD, the factors associated with ADHD and brain dysfunction, the current pharmacological treatments of ADHD, Ritalin, and the potential risks and side effects. Behavior modification and cognitive behavioral treatment for ADHD is discussed as well. Lastly, a brief history of the study of neurofeedback, treatment

successes and clinical benefits, comparisons to medication, and limitations are presented.

Loo[95] 2005

Electrophysiological measures were among the first to be used to study brain processes in children with attention deficit hyperactivity disorder (ADHD; Diagnostic and Statistical Manual of Mental Disorders [4th ed.], American Psychiatric Association, 1994) and have been used as such for over 30 years (see Hastings & Barkley, 1978, for an early review). More recently, electroencephalography (EEG) has been used both in research to describe and quantify the underlying neurophysiology of ADHD, but also clinically in the assessment, diagnosis, and treatment of ADHD. This review will first provide a brief overview of EEG and then present some of the research findings of EEG correlates in ADHD. Then, the utility of EEG in making an ADHD diagnosis and predicting stimulant response will be examined. **Finally, and more controversially, we will review the results of the most recent studies on EEG biofeedback (neurofeedback) as a treatment for ADHD and the issues that remain to be addressed in the research examining the efficacy this therapeutic approach.**

Monastra[96] 2005 (and 2005[97])

Historically, pharmacological treatments for attention-deficit/hyperactivity disorder (ADHD) have been considered to be the only type of interventions effective for reducing the core symptoms of this condition. However, during the past three decades, a series of case and controlled group studies examining the effects of EEG biofeedback have reported improved attention and behavioral control, increased cortical activation on quantitative electroencephalographic examination, and gains on tests of intelligence and academic achievement in response to this type of treatment. This review paper critically examines the empirical evidence, applying the efficacy guidelines jointly established by the Association for Applied Psychophysiology and Biofeedback (AAPB) and the International Society for Neuronal Regulation (ISNR). **On the basis of these scientific principles, EEG biofeedback was determined to be "probably efficacious" for the treatment of ADHD**. Although significant clinical improvement was reported in approximately 75% of the patients in each of the published research studies, **additional randomized, controlled group studies are needed in order to provide a better estimate** of the percentage of patients with ADHD who will demonstrate such gains in clinical practice.

Rojas[98] 2005

Use of complementary and alternative medicine (CAM) for treatment of attention-deficit hyperactivity disorder (ADHD) has become widespread in both referral and primary care populations. We review the purported mechanism of action and available evidence for selected CAM therapies for ADHD. Enduring controversies, such as elimination of artificial food additives, colors, and/or preservatives; the effect of sugar on behavior in children; and the use of EEG biofeedback, have been well

studied but lack support as effective sole treatments for ADHD. The initial evidence for some emerging CAM therapies, such as essential fatty acid supplementation, yoga, massage, homeopathy, and green outdoor spaces, suggests potential benefits as part of an overall ADHD treatment plan. **More rigorously designed studies are needed to evaluate their effectiveness as single therapy for ADHD**. Copyright 2005 Wiley-Liss, Inc.

Butnik[99] 2005

Neurofeedback is being utilized more commonly today in treating individuals who have attention deficit hyperactivity disorder (ADHD). Neurofeedback, which is based on theories that recognize the organic basis of ADHD, utilizes biofeedback to guide individuals to regulate their brain activity. Neurofeedback relies on research that has demonstrated that most individuals who have ADHD, as compared to matched peers, have excess slow wave activity and reduced fast wave activity. It provides immediate feedback to the individual about his or her brain wave activity in the form of a video game, whose action is influenced by the individual's meeting predetermined thresholds of brain activity. Over several sessions of using the video and auditory feedback, individuals reduce their slow wave activity and/or increase their fast wave activity. Individuals who complete a course of training sessions often show reduced primary ADHD symptoms. **Research has shown that neurofeedback outcomes compare favorably to those of stimulant medication**. Copyright 2005 Wiley Periodicals, Inc

Rossiter[100] 2004

The paper examines major criticisms of AD/HD (Attention Deficit/Hyperactivity Disorder) neurofeedback research using T. R. Rossiter and T. J. La Vaque (1995) as an exemplar and discusses relevant aspects of research methodology. J. Lohr, S. Meunier, L. Parker, and J. P. Kline (2001), D. A. Waschbusch and G. P. Hill (2001), and J. P. Kline, C. N. Brann, and B. R. Loney (2002) criticized Rossiter and La Vaque for (1) using an active treatment control; (2) nonrandom assignment of patients; (3) provision of collateral treatments; (4) using nonstandardized and invalid assessment instruments; (5) providing artifact contaminated EEG feedback; and (6) conducting multiple non-alpha protected t tests. The criticisms, except those related to statistical analysis, are invalid or are not supported as presented by the authors. They are based on the critics' unsubstantiated opinions; require redefining Rossiter and La Vaque as an efficacy rather than an effectiveness study; or reflect a lack of familiarity with the research literature. However, there are broader issues to be considered. Specifically, what research methodology is appropriate for studies evaluating the effectiveness of neurofeedback and who should make that determination? **The uncritical acceptance and implementation of models developed for psychotherapy, pharmacology, or medical research is premature and ill-advised. Neurofeedback researchers should develop models that are appropriate to the technology, treatment paradigms, and goals of neurofeedback outcome studies. They need to explain the rationale for their research methodology and defend their choices.**

Doggett[101] 2004

The purpose of this article is to discuss alternative treatments other than drug therapy for Attention-Deficit/Hyperactive Disorder (ADHD) in educational settings. There is an increasing body of knowledge that supports interventions for improving cognitive outcomes without the use of medication. The article explores the risks to ADHD children, shows the potential linkage between gifted children and ADHD, explores recent brain research, and examines various alternative treatment options. Information is presented on alternative treatments such as cognitive behavioral therapies, educational interventions, electroencephalograph (EEG) neuro-feedback, and diet.

Brue[102] 2002

Attention-deficit/hyperactivity disorder (ADHD) affects approximately 2 to 3 million children in the United States. Stimulant medication is one of the most common treatments for ADHD; however, adverse reactions from its use cause many parents to seek complementary or alternative treatments. Many individuals use complementary and alternative medicine (CAM) because they are attracted to CAM philosophies and health beliefs, dissatisfied with the process or results of their conventional care, or concerned about adverse effects of stimulants. The success of CAM in treating children with ADHD varies, and parents typically use a trial-and-error method when evaluating CAM. **Alternative treatments often include neurofeedback**, homeopathy, herbal medicines, iron supplements, and dietary modifications or supplements. Although anecdotal and empirical evidence is surfacing to support the efficacy of these alternatives, further research is needed before they can be regarded as effective, reliable treatments for ADHD. Therefore, the use of more conventional treatments should be considered if alternative interventions prove unsuccessful.

Ramirez[103] 2001

Literature searches dating back to 1968 were conducted through Psychlit and Medline services to review the scientific literature on EEG biofeedback treatment of ADD. While anecdotal and case reports cite promising evidence, methodological problems coupled with a paucity of research precludes any definitive conclusions as to the efficacy of enhanced alpha and hemisphere-specific EEG biofeedback training. **One of the more promising EEG biofeedback treatment paradigms involves theta/beta training. Studies have reported that academic, intellectual, and behavioral gains have been attained with this approach.** Significant behavioral and cognitive changes have also been reported following SMR training. However, research into these treatment approaches has also been marred by methodological inadequacies and lack of sufficient follow-up studies. A number of recommendations for future research into this treatment approach are made.

Mamtani[104] 2002

The use of complementary and alternative medicine (CAM) is widespread. Those

with psychiatric disorders are more likely to use CAM than those with other diseases. There are both benefits and limitations to CAM. **Many controlled studies have yielded promising results in the areas of chronic pain, insomnia, anxiety, and depression.** There is sufficient evidence, for example, to support the use of a) acupuncture for addiction problems and chronic musculoskeletal pain, b) hypnosis for cancer pain and nausea, c) massage therapy for anxiety, and the use of d) mind-body techniques such as meditation, relaxation, and **biofeedback for pain, insomnia, and anxiety**. Large doses of vitamins, herbal supplements, and their interaction with conventional medications are areas of concern. Physicians must become informed practitioners so that they can provide appropriate and meaningful advice to patients concerning benefits and limitations of CAM.

Wickramasekera[105] 1999

Changes in the magnitude and direction of physiological measures (EMG, EEG, temperature, etc.) are not strongly related to the reduction of clinical symptoms in biofeedback therapy. Previously, nonspecified perceptual, cognitive, and emotional factors related to threat perception (Wickramasekera, 1979, 1988, 1998) may account for the bulk of the variance in the reduction of clinical symptoms. **The mean magnitude of these previously nonspecified or placebo factors is closer to 70% when both the therapist and patient believe in the efficacy of the therapy.** This powerful placebo effect is hypothesized to be an elicited conditioned response (Wickramasekera, 1977a, 1977c, 1980, 1985) based on the memory of prior healings. These memories of healing are more resistant to extinction if originally acquired on a partial rather than continuous reinforcement schedule. High and low hypnotic ability in interaction with threat perception (negative affect) is hypothesized to contribute to both the production and reduction of clinical symptoms. High and low hypnotic ability respectively are hypothesized to be related to dysregulation of the sympathetic and parasympathetic arms of the autonomic nervous system. **Biofeedback is hypothesized to be most effective for reducing clinical symptoms in people of low to moderate hypnotic ability. For people high in trait hypnotic ability, training in self-hypnosis or other instructional procedures (e.g., autogenic training, progressive muscle relaxation, mediation, CBT, etc.) will produce the most rapid reduction in clinical symptoms.**

Cortoos[106] 2006

Insomnia has usually been studied from a behavioral perspective. Somatic and/or cognitive conditioned arousal was shown to play a central role in sleep complaints becoming chronic, and was used as a starting point for the development of treatment modalities. The introduction of the neurocognitive perspective, with its focus on cortical or CNS arousal, has given rise to a renewed interest in the neurophysiological characteristics of insomnia. Recent research, using quantitative EEG, neuroimaging techniques and the study of the microstructure of sleep, suggests a state of hyperarousal with a biological basis. Furthermore, insomnia might not be restricted to sleep complaints alone because it appears to be a 24-h disorder, affecting several aspects of daytime functioning as well. These new findings have

implications for the treatments used and indicate that a focus on cortical or CNS arousal should be pursued. **As such, the use of EEG neurofeedback, a self-regulation method based on the paradigm of operant conditioning, might be a promising treatment modality.** Preliminary results for insomnia and successful applications for other disorders suggest that this treatment can have the necessary stabilizing effects on the EEG activity, possibly resulting in a normalizing effect on daytime as well as nighttime functioning.

Weiskopf[107] 2004

Functional magnetic resonance imaging (fMRI) measures the blood oxygen level-dependent (BOLD) signal related to neuronal activity. So far, this technique has been limited by time-consuming data analysis impeding on-line analysis. In particular, no brain-computer interface (BCI) was available which provided on-line feedback to learn physiological self-regulation of the BOLD signal. **Recently, studies have shown that fMRI feedback is feasible and facilitates voluntary control of brain activity**. Here we review these studies to make the fMRI feedback methodology accessible to a broader scientific community such as researchers concerned with functional brain imaging and the neurobiology of learning. Methodological and conceptual limitations were substantially reduced by artefact control, sensitivity improvements, real-time algorithms, and adapted experimental designs. Physiological self-regulation of the local BOLD response is a new paradigm for cognitive neuroscience to study brain plasticity and the functional relevance of regulated brain areas by modification of behaviour. Voluntary control of abnormal activity in circumscribed brain areas may even be applied as psychophysiological treatment.

Blakemore[108] 2000

It is well known that you cannot tickle yourself. Here, we discuss the proposal that such attenuation of self-produced tactile stimulation is due to the sensory predictions made by an internal forward model of the motor system. A forward model predicts the sensory consequences of a movement based on the motor command. When a movement is self-produced, its sensory consequences can be accurately predicted, and this prediction can be used to attenuate the sensory effects of the movement. Studies are reviewed that demonstrate that as the discrepancy between predicted and actual sensory feedback increases during self-produced tactile stimulation there is a concomitant decrease in the level of sensory attenuation and an increase in tickliness. **Functional neuroimaging studies have demonstrated that this sensory attenuation might be mediated by somatosensory cortex and anterior cingulate cortex: these areas are activated less by a self-produced tactile stimulus than by the same stimulus when it is externally produced. Furthermore, evidence suggests that the cerebellum might be involved in generating the prediction of the sensory consequences of movement. Finally, recent evidence suggests that this predictive mechanism is abnormal in patients with auditory hallucinations and/or passivity experiences.**

Lincoln[109] 2006

Several authors have suggested that devices delivering altered auditory feedback (AAF) may be a viable treatment for adults and children who stutter. This paper reviews published, peer reviewed journal papers from the past 10 years that investigate the effect of AAF during different speaking conditions, tasks and situations. A review of that literature indicates that considerable experimental evidence and limited Phase 1 treatment outcome evidence has been accumulated about the effect of AAF on the speech of people who stutter. **However, critical knowledge about the effect of AAF during conversational speech and in everyday speaking situations is missing. Knowledge about how to determine the correct levels of AAF for individuals, and the characteristics of those likely to benefit from AAF, also needs to be established. At present there is no reason to accept a recent suggestion that AAF devices would be a defensible clinical option for children.** In general device development and availability has occurred at a faster pace than clinical trials research. (…)

12.1.1 Zusammenfassung psychische Störungen

Neuro – bzw. Biofeedback scheint wirksam bei Angststörungen (Hammond 2005, Moore 2000), Schlaflosigkeit (Morin 1999, Cortoos 2006), ADHD (Hirshberg 2005, Nash 2000, Holtmann 2004 + 2006, Monastra 2005, Butnik 2005, Ramirez 2001, Mamtani 2002), die methodische Qualität der Studien wird jedoch von allen Autoren kritisiert.

Verhaltenstherapien bieten die Möglichkeit der Selbstkontrolle (Weiskopf 2004, Blakemore 2000).

Verhaltenstherapien benötigen den Glaubensfaktor oder Placeboeffekt (Basmajian 1999, Moss 2002, Wickramasekera 1999), es besteht keine Klarheit über die Wirkung (Brue 2002, Loo 2005), es gibt keine hochwertigen Studien (Rojas 2005, Rossiter 2004) und keine Empfehlung für den Einsatz in der Therapie gegen Stottern bei Kindern (Lincoln 2006).

13 Andere Einsatzgebiete für Biofeedback

13.1 Fibromyalgie

	Patienten mit	Outcome	Aussage der Studie
36: Gur A. Physical therapy modalities i...[PMID: 16454722]	Fibromyalgie	Besserung	Keine klare Aussage möglich, Bedarf nach RCTs zum Thema
134: Holdcraft LC et al. Complementary and alternative...[PMID: 12849718]	Fibromyalgie	Besserung	Es gibt einen RCT mit positiven Resultaten für Biofeedback
210: Hadhazy VA et al. Mind-body therapies for the t...[PMID: 11128685]	Fibromyalgie	Besserung	Für bestimmte Outcomes besteht schwache Evidenz der Überlegenheit gegenüber Placebo oder Physiotherapie
215: Offenbacher M et al. Physical therapy in the treat...[PMID: 11028838]	Fibromyalgie	Besserung	Biofeedback kann Einfluss haben
252: Berman BM et al. Complementary medicine treatm...[PMID: 10562380]	Fibromyalgie	Besserung	Die besten Daten existieren für mind-body-Therapien

Gur[110] 2006

The **etiology of fibromyalgia syndrome (FM) is uncertain** and the prognosis for symptomatic recovery is generally poor. A wide variety of interventions are used in the management of FM. **There is**, however, **no clear consensus on the treatment** of choice and FM remains relatively refractory to treatment. (…) Despite the positive results found, the number of publications related to the application of physical therapy modalities such as acupuncture, transcutaneous electrical stimulation, laser, **biofeedback**, electrotherapy and magnetic field is still scant, especially concerning FM treatment. (…). It can be concluded that there is a **need for larger, more systematic and methodologically sound randomised controlled clinical trials** to evaluate the effectiveness of physical therapy modalities of managing FM. (…)

Holdcraft[111] 2003

Complementary and alternative medicine (CAM) has gained increasing popularity, particularly among individuals with fibromyalgia syndrome (FMS) for which traditional medicine has generally been ineffective. A systematic review of randomized controlled trials (RCTs) and non-RCTs on CAM studies for FMS was conducted to evaluate the empirical evidence for their effectiveness. Few RCTs achieved high scores on the CONSORT, a standardized evaluation of the quality of methodology reporting. Acupuncture, some herbal and nutritional supplements (magnesium, SAMe) and massage therapy have the best evidence for effectiveness with FMS. Other CAM therapies **have** either **been evaluated in only one RCT with positive**

results (Chlorella, biofeedback, relaxation), in multiple RCTs with mixed results (magnet therapies), or have positive results from studies with methodological flaws (homeopathy, botanical oils, balneotherapy, anthocyanidins, dietary modifications). Lastly, other CAM therapies have neither well-designed studies nor positive results and are not currently recommended for FMS treatment (chiropractic care).

Hadhazy[112] 2000

OBJECTIVE: To assess the effectiveness of mind-body therapy (MBT) for fibromyalgia syndrome (FM) by systematically reviewing randomized/ quasirandomized controlled trials using methods recommended by the Cochrane Collaboration. (…) RESULTS: Thirteen trials involving 802 subjects were included. Seven trials received a high methodological score. Compared to waiting list/treatment as usual, there is strong evidence that MBT is more effective for self-efficacy, limited evidence for quality of life, inconclusive evidence for all other outcomes. There is limited evidence that MBT is more effective than placebo (for pain and global improvement); inconclusive evidence that MBT is more effective than physiotherapy, psychotherapy, or education/attention control for all outcomes; strong evidence that moderate/high intensity exercise is more effective than MBT (for pain and function). There is moderate evidence that MBT plus exercise (MBT+E) is more effective than waiting list/treatment as usual (for self-efficacy and quality of life); limited evidence that MBT+E is more effective than education/attention control; inconclusive for other outcomes. There is inconclusive evidence for MBT+E vs other active treatments for all outcomes. Longterm within-groups results show greatest benefit for MBT+E. CONCLUSION: **MBT is more effective for some clinical outcomes compared to waiting list/treatment as usual or placebo. Compared to active treatments, results are largely inconclusive, except for moderate/high intensity exercise, where results favor the latter.** Further research needs to focus on the synergistic effects of MBT plus exercise and/or plus antidepressants.

Offenbacher[113] 2000

(…) We systematically reviewed current treatment options in the treatment of fibromyalgia. Based on evidence from randomized controlled trials cardiovascular fitness training importantly improves cardiovascular fitness, both subjective and objective measures of pain as well as subjective energy and work capacity and physical and social activities. Based on anecdotal evidence or small observational studies physiotherapy may reduce overloading of the muscle system, improve postural fatigue and positioning, and condition weak muscles. Modalities and whole body cryotherapy may reduce localized as well as generalized pain in short term. Trigger point injection may reduce pain originating from concomitant trigger points in selected FM patient. Massage may reduce muscle tension and may be prescribed as a adjunct with other therapeutic interventions. Acupuncture may reduce pain and increase pain threshold. **Biofeedback may positively influence subjective and objective disease measures.** TENS may reduce localized musculoskeletal pain in fibromyalgia. While there seems to be no single best treatment option, physical therapy seem to reduce disease consequences. (…)

Berman[114] 1999

Fibromyalgia is a chronic-pain-related syndrome associated with high rates of complementary and alternative medicine (CAM) use. Among the many CAM therapies frequently used by fibromyalgia patients, empirical research data exist to support the use of only three: (1) mind-body, (2) acupuncture, and (3) manipulative therapies for treating fibromyalgia. **The strongest data exist for the use of mind-body techniques (e.g. biofeedback, hypnosis, cognitive behavioural therapy), particularly when utilized as part of a multidisciplinary approach to treatment**. The weakest data exist for manipulative techniques (e.g. chiropractic and massage). The data supporting the use of acupuncture for fibromyalgia are only moderately strong. Also, for some fibromyalgia patients, acupuncture can exacerbate symptoms, further complicating its application for this condition. Further research is needed not only in these three areas, but also for other treatments being frequently utilized by fibromyalgia patients.

13.1.1 Zusammenfassung Fibromyalgie

Keine klare Aussage und die Forderung nach mehr RCTs findet sich bei Gur 2006 und Offenbacher 2000, über einen RCT mit positiven Resultaten für Biofeedback bei Fibromyalgie berichtet Holdcraft 2003, Überlegenheit von Biofeedback gegenüber Placebo findet Hadhazy 2000, und Berman 1999 berichtet, dass für Biofeedback noch die besten Daten existieren unter sämtlichen alternativen Methoden.

13.2 Kiefersperre

	Patienten mit	Outcome	Studienaussage
16: Medlicott MS et al. A systematic review of the ef...[PMID: 16813476]	Kiefersperre	Mundöffnung	Biofeedback kann bessere Wirkung haben als Placebo
23: McNeely ML et al. A systematic review of the ef...[PMID: 16649894]	Kiefersperre	Mundöffnung	Signifikante Erfolge erreichen Biofeedback, Entspannungs und low level Lasertherapie
41: Crider A et al. Efficacy of biofeedback-based...[PMID: 16385422]	Kiefersperre	Mundöffnung	Wirksame Behandlung

Medlicott[115] 2006

BACKGROUND AND PURPOSE: This systematic review analyzed studies examining the effectiveness of various physical therapy interventions for temporomandibular disorder. METHODS: Studies met 4 criteria: (1) subjects were from 1 of 3 groups identified in the first axis of the Research Diagnostic Criteria for Temporomandibular Disorders, (2) the intervention was within the realm of physical therapist practice, (3) an experimental design was used, and (4) outcome measures

assessed one or more primary presenting symptoms. Thirty studies were evaluated using Sackett's rules of evidence and 10 scientific rigor criteria. Four randomly selected articles were classified independently by 2 raters (interrater agreement of 100% for levels of evidence and 73.5% for methodological rigor). RESULTS: The following recommendations arose from the 30 studies: (1) active exercises and manual mobilizations may be effective; (2) postural training may be used in combination with other interventions, as independent effects of postural training are unknown; (3) mid-laser therapy may be more effective than other electrotherapy modalities; (4) **programs involving relaxation techniques and biofeedback, electromyography training, and proprioceptive re-education may be more effective than placebo treatment or occlusal splints**; and (5) combinations of active exercises, manual therapy, postural correction, and relaxation techniques may be effective. DISCUSSION AND CONCLUSION: These recommendations should be viewed cautiously. Consensus on defining temporomandibular joint disorder, inclusion and exclusion criteria, and use of reliable and valid outcome measures would yield more rigorous research.

McNeely[116] 2006

BACKGROUND AND PURPOSE: The purpose of this qualitative systematic review was to assess the evidence concerning the effectiveness of physical therapy interventions in the management of temporomandibular disorders. METHODS: A literature search of published and unpublished articles resulted in the retrieval of 36 potential articles. RESULTS: Twelve studies met all selection criteria for inclusion in the review: 4 studies addressed the use of therapeutic exercise interventions, 2 studies examined the use of acupuncture, and 6 studies examined electrophysical modalities. Two studies provided evidence in support of postural exercises to reduce pain and to improve function and oral opening. One study provided evidence for the use of manual therapy in combination with active exercises to reduce pain and to improve oral opening. One study provided evidence in support of acupuncture to reduce pain when compared with no treatment; however, in another study no significant differences in pain outcomes were found between acupuncture and sham acupuncture. **Significant improvements in oral opening were found with muscular awareness relaxation therapy, biofeedback training, and low-level laser therapy treatment.** DISCUSSION AND CONCLUSION: Most of the studies included in this review were of very poor methodological quality; therefore, the findings should be interpreted with caution.

Crider[117] 2005

Bibliographic searches identified 14 controlled and uncontrolled outcome evaluations of biofeedback-based treatments for temporomandibular disorders published since 1978. This literature includes two randomized controlled trials (RCTs) of each of three types of biofeedback treatment: (1) surface electromyographic (SEMG) training of the masticatory muscles, (2) SEMG training combined with adjunctive cognitive-behavioral therapy (CBT) techniques, and (3) biofeedback-assisted relaxation training (BART). A detailed review of these six RCTs, supplemented with information

from non-RCT findings, was conducted to determine the extent to which each type of intervention met treatment efficacy criteria promulgated by the Association for Applied Psychophysiology and Biofeedback (AAPB). We conclude that SEMG training with adjunctive CBT is an **efficacious treatment for temporomandibular disorders** and that both SEMG training as the sole intervention and BART are probably efficacious treatments. (…)

13.2.1 Zusammenfassung Temporomandibuläre Störungen (Kiefersperre)

Medlicott 2006 beschreibt Biofeedback als besser als Placebo, McNeely 2006 findet signifikante Therapieerfolge und Crider 2005 sieht Biofeedback als wirksame Behandlung bei Kiefersperre.

13.3 Einzelreviews zu verschiedenen Themen

	Patienten mit	Outcome	Studienaussage
240: Thatcher RW. EEG operant conditioning (bio...[PMID: 10638351]	Schädel-Hirn-Trauma	Symptomverbesserung	Keine klare Aussage im Abstract
81: Thornton KE et al. Electroencephalogram biofeedb...[PMID: 15564056]	Schädel-Hirn-Trauma	Symptomverbesserung	Es gibt Gründe zu glauben, dass für gewisse Zielkonditionen Biofeedback nach SHT fruchtbar sein kann
124: Platz T. [Evidence-based arm rehabilit...[PMID: 14551687]	Arm Rehabilitation	Beweglichkeit	Biofeedback effektiv bei Armparese
102: Ritz T et al. Behavioral interventions in a...[PMID: 15193969]	Asthma	Anfallsreduktion	Derzeit keine gute Evidenz
131: Shenefelt PD. Biofeedback, cognitive-behavi...[PMID: 12919113]	Hautproblem	Besserung	Kann Hauptprobleme bessern, vor allem in Kombination mit Hypnose
272: Bilkis MR et al. Mind-body medicine. Practical...[PMID: 9828881]	Hautproblem	Besserung	Keine klare Aussage im Abstract
42: Meningaud JP et al. Drooling of saliva: a review ...[PMID: 16360607]	Speichelfluss	Besserung	Biofeedback kommt zum Einsatz
76: Locatelli F et al. Haemodialysis with on-line mo...[PMID: 15632348]	Haemodialyse mit on-line monitoring	Komplikationsvermeidung	Biofeedback monitoring während der Dialyse kann Komplikationen verhindern
104: Nyland J et al. Therapeutic modality: rehabil...[PMID: 15183573]	Sportverletzung		Alternative Rehabilitation des verletzten Sportlers beinhaltet Biofeedback
259: Manyam BV et al. Traditional and complementary...[PMID: 10410773]	Parkinson	Angstreduktion	Biofeedback hat möglicherweise einen positiven Effekt
34: Maryn Y et al. Effects of biofeedback in pho...[PMID: 16514557]	phonetischen Störungen	Besserung	Positive Tendenz, aber wenig hochwertige Studien
8: Karavidas MK et al. Thermal biofeedback for prima...[PMID: 17016765]	Raynaud	others	Thermisches Biofeedback effektiv – Evidenzlevel IV
112: van Dijk H et al. Distance training for the res...[PMID: 15068640]	beeinträchtigter Muskelfunktion	Wiederherstellung	Wissenschaftliche Evidenz existiert für Biofeedback
82: Trudeau DL. Applicability of brain wave b...[PMID: 15564055]	Jugendliche mit Suchtmittelmißbrauch	Entzug	Biofeedback ist vielversprechend, weil medikationsfrei

Thatcher[118] 2000

A review is presented of the currently sparse literature about EEG operant conditioning or **biofeedback as a treatment to reduce symptomology and patient complaints following a traumatic brain injury**. The paper also evaluates the general use of quantitative EEG (QEEG) to assess traumatic brain injury and to facilitate EEG biofeedback treatment. The use of an age matched reference normative QEEG database and QEEG discriminant function are presented as a method to evaluate the nature or neurological basis of a patient's complaints as well as to individualize an efficient and optimal feedback protocol and to help evaluate the efficacy of the biofeedback therapy. Univariate and multivariate statistical issues are discussed, different classes of experimental designs are described and then a "double blind" research study is proposed in an effort to encourage future research in the area of EEG biofeedback for the treatment and rehabilitation of traumatic brain injury.

Thornton[119] 2005

The application of electroencephalogram (EEG) biofeedback with reading disability and traumatic brain injury (TBI) is relatively recent(…) This suggests the possibility that EEG biofeedback specifically aimed at remediating reading disability and TBI would be effective. This article provides strong initial support for this idea and provides **reason to believe that assessment and training under task conditions are likely to be fruitful**. Given the significance of these problems and the absence of very effective alternatives for remediation of these conditions, efforts to complete the needed research seem warranted. (…)

Platz[120] 2003

Based on a systematic MEDLINE search and informal sources, 40 references were identified that evaluate training therapy or neuromuscular electric stimulation for arm paresis after stroke and describe either a systematic review, meta-analysis, randomised controlled trial, or controlled cohort study. The evidence was grouped into three areas of interest: comparison of physiotherapy schools, effects of intensity of training, and efficacy of specific arm rehabilitation techniques. The only physiotherapy school with evidence of superior efficacy was the task-oriented 'motor relearning programme'. Higher intensities of motor rehabilitation can accelerate motor recovery. **Various training techniques with demonstrated efficacy are available for specific patient subgroups**: arm ability training for mildly affected patients with reduced efficiency of motor control, constrained-induced movement therapy for patients with partial functional deficits and learned nonuse of the affected arm, and repetitive sensorimotor training techniques, **EMG-biofeedback, functional electrical stimulation, and robot-assisted training for patients with severe arm paresis**.

Ritz[121] 2004

OBJECTIVES: Biofeedback techniques have long been recommended as an adjunctive treatment for bronchial asthma. Techniques that target lung function

directly, or indirectly by altering facial muscle tension, heart rate, heart rate variability (HRV) or inspiratory volume together with accessory muscle tension, have been proposed. We review evidence for the effectiveness of these biofeedback interventions and discuss the psychophysiological rationale behind individual techniques. METHOD: Controlled studies of biofeedback in asthma were retrieved using relevant search engines and reference lists of published articles. Effect sizes comparing intervention with control groups were calculated where appropriate. RESULTS: Most of the studies suffer from **methodological inadequacies** or poor reporting of methods and results. Interventions targeting respiratory resistance directly have yielded only small and inconsistent changes in lung function and are difficult to implement without producing dynamic hyperinflation. Biofeedback-assisted facial muscle relaxation as an indirect intervention has yielded mixed results across studies, with only half of the studies showing significant albeit very small and clinically irrelevant improvements in lung function. The underlying physiological assumptions of the technique are questionable in the light of current knowledge of respiratory physiology. For other indirect techniques, only preliminary evidence of small effects is available. CONCLUSION: Currently, **there is little good evidence that biofeedback techniques can contribute substantially to the treatment of asthma.**

Shenefelt[122] 2003

Biofeedback can improve cutaneous problems that have an autonomic nervous system component. Examples include biofeedback of galvanic skin resistance (GSR) for hyperhidrosis and biofeedback of skin temperature for Raynaud's disease. Hypnosis may enhance the effects obtained by biofeedback. Cognitive-behavioral methods may resolve dysfunctional thought patterns (cognitive) or actions (behavioral) that damage the skin or interfere with dermatologic therapy. Responsive diseases include acne excoriee, atopic dermatitis, factitious cheilitis, hyperhidrosis, lichen simplex chronicus, needle phobia, neurodermatitis, onychotillomania, prurigo nodularis, trichotillomania, and urticaria. (…)

Bilkis[123] 1998

It is only recently that Western physicians are rediscovering the link between thought and health. The spectrum of causative factors in inflammatory dermatoses are often multifactorial. **Stress and negative thoughts are major factors in dermatologic conditions.** This article begins with some basic information on the ways that thoughts affect health. **Practical methods of intervention including meditation, journal writing, affirmations, prayer, biofeedback, and hypnosis are presented**.

Meningaud[124] 2006

Drooling of saliva appears to be the consequence of a dysfunction in the coordination of the swallowing mechanism, resulting in excess pooling of saliva in the anterior portion of the oral cavity and the unintentional loss of saliva from the mouth. Drooling can produce significant negative effects on physical health and quality of life,

especially in patients with chronic neurological disabilities. **Various approaches to manage this condition have been described in the literature, including oral motor therapy, behavior modification via biofeedback**, orofacial regulation therapy, drug therapy, radiotherapy, and surgical treatments. Minimally invasive modalities, such as injection of botulinum toxin, photocoagulation, and acupuncture, have also been reported. This article provides a comprehensive and thorough overview of drooling, with an emphasis on understanding its etiologies and modalities of treatment.

Locatelli[125] 2005

BACKGROUND: On-line monitoring of chemical/physical signals during haemodialysis (HD) and bio-feedback represents the first step towards a 'physiological' HD system incorporating adaptive and logic controls in order to achieve pre-set treatment targets. METHODS: Discussions took place to achieve a consensus on key points relating to on-line monitoring and bio-feedback, focusing on the clinical applications. (…) A bio-feedback system drives the relative BV reduction according to desired values by instantaneously changing the ultrafiltration rate and the dialysate conductivity. This system has proved to reduce the incidence of intra-HD hypotension episodes significantly. Ionic dialysance and the patient's plasma conductivity can be calculated easily from on-line inlet and outlet dialysate conductivity measurements at two different steps of dialysate conductivity. (…) This is associated with improved intra-HD cardiovascular stability. The module can also be used to quantify total recirculation. CONCLUSIONS: **On-line monitoring devices and bio-feedback systems have evolved from toys for research use to tools for routine clinical application, particularly in patients with clinical complications**. Conductivity monitoring appears the most versatile tool, as it permits quantification of delivered dialysis dose, achievement of sodium balance and surveillance of vascular access function, potentially at each dialysis session and without extra cost.

Nyland[126] 2004

Traditional therapeutic modalities include cryotherapy, sonotherapy, pulsed electrical stimulation, transcutaneous electrical nerve stimulation, high-volt pulsed current, and iotopheresis. **Alternative modalities include** acupuncture, magnetic field therapy, **biofeedback**,and massage. All therapeutic modalities should be considered adjuncts to progressive functional exercise. Controlled studies rarely reach consensus regarding the efficacy of therapeutic modalities,so their use should be individualized to the patient.

Manyam[127] 1999

Parkinson's disease has existed in different parts of the world since ancient times. The first clear description is found in the ancient Indian medical system of Ayurveda under the name Kampavata. Traditional therapies in the form of herbal preparations containing anticholinergics, levodopa, and monoamine oxidase inhibitors were used in the treatment of PD in India, China, and the Amazon basin. Scientific reevaluation

of these therapies may be valuable, as shown in the case of Mucuna pruriens and Banisteria caapi. Complementary therapies such as massage therapy, **biofeedback,** and acupuncture **may have beneficial effects** for patients and deserve further study.

Maryn[128] 2006

The purpose of this article was to systematically review the literature on the effects of biofeedback therapy in the domain of phonatory disorders and phonatory performance, using studies in peer-reviewed journals. An extensive definition of biofeedback is given and its place in voice treatment is defined. Eighteen group or case studies or reports considering the effects of electromyographic, laryngoscopic and acoustic biofeedback in dysphonic patients (hyperfunctional voice disorders, hypofunctional voice disorders, psychogenic voice disorder, laryngeal trauma, total laryngectomy, vocal cord dysfunction) and participants with normal voices are included and an analysis of procedure as well as research design and results is presented. **The usefulness of biofeedback in phonatory disorders and performance was to be interpreted based on tendencies, since there is a lack of randomized controlled efficacy studies. In only 3 of 18 studies (16.7%) did biofeedback therapy fail to improve voice quality or not result in better results than other forms of therapy.** Recommendations for improved methodologies are made, which include the use of acoustic voice quality parameters.

Karavidas[129] 2006

The clinical presentation of primary Raynaud's phenomenon (RP) derives from various pathogenic triggers. The use of thermal biofeedback (TBF) may be of benefit in reducing the severity and frequency of attacks. This article summarizes the relevant research regarding the pathophysiology of primary RP and mechanism of TBF for RP. Systematic reviews of the efficacy of TBF for RP and treatment guidelines for clinicians are provided. **The panel concludes that the level of evidence for TBF efficacy is categorized as Level IV: efficacious**. The rationale, based on three randomized controlled trials conducted in independent laboratories, demonstrated "superiority or equivalence" of treatments that include TBF. However, randomly controlled trials (RCT) with positive clinical outcomes tended to be small. A large RCT with negative results did not effectively teach handwarming skills. Procedures for reviewing and rating of the levels of evidence of efficacy of studies was based on the Template for Developing Guidelines for the Evaluation of the Clinical Efficacy of Psychophysiological Interventions developed by the joint task force of the AAPB and the Society for Neuronal Regulation (SNR).

Van Dijk[130] 2004

We reviewed the literature on distance training for the restoration of motor function. Computerized literature searches were performed using the MEDLINE, EMBASE, Cinahl and Cochrane databases. (…) The review revealed some promising applications of distance motor training, such as virtual reality (VR) and robotic

devices. The strength of the evidence from these studies was poor, however, probably because the technology is relatively new. In contrast to the studies using VR and robotic devices, **those using electromyographic (EMG) biofeedback showed a good to fair strength of scientific evidence.** This can be explained by the substantial history of research on the restoration of motor function through the use of EMG biofeedback techniques.

Trudeau[131] 2005

Neurofeedback treatment for addictions in adults is probably efficacious, and several reported approaches are described with their indications. **Neurofeedback is promising as a treatment modality for adolescents, especially those with stimulant abuse and attention and conduct problems. It is attractive as a medication-free, neurophysiologic, and self-actualizing treatment for a substance-based, brain-impaired and self-defeating disorder. More research**, beginning with case reporting, is needed to assess use and efficacy in adolescents.

13.3.1 Zusammenfassung Sonstige Beschwerden

Keine klare Aussage über Biofeedback gibt es in der Behandlung von Patienten nach Schädel-Hirn-Trauma (Thatcher 2000, Thornton 2005), effektiv ist Biofeedback in der Armparese-Behandlung (Platz 2003), keine gute Evidenz gibt es für die Behandlung von Asthma (Ritz 2004), Biofeedback kann Hautprobleme bessern (Shenafelt 2003, Bilkis 1998), wird bei vermehrtem Speichelfluss eingesetzt (Meningaud 2006), sowie als alternative Rehabilitationsmethode beim verletzten Sportler (Nyland 2004), und kann bei Angst von Parkinson-Patienten wirken (Manyam 1999).

Interessant klingt der Einsatz von Biofeedback Methoden während der Dialysebehandlung zum exakten Monitoring für frühzeitige Erkennung auftretender Komplikationen (Locatelli 2005).

In der Behandlung von phonetischen Störungen berichtet Maryn 2006 positive Tendenz für Biofeedback, die Effektivität desselben für die Behandlung des Morbus Reynaud wird auf Evidenzlevel IV belegt (Karavidas 2006), für die Wiederherstellung der Bewegungsfunktion existiert wissenschaftliche Evidenz (Van Dijk 2004), vielversprechend ist Biofeedback in der Behandlung von Jugendlichen mit Substanzmißbrauch, wobei hier noch weitere Forschung nötig ist (Trudeau 2005).

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