

The Effect of Audio-Visual Biofeedback on Muscle Relaxation

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Abstract – The aim of the study was to explore the effect of audio-visual biofeedback on patients' ability to control their own muscle tension, relaxing them. The upper trapezius muscle, which is located on the back of the neck and shoulder part being one of the most tensed human muscles, was studied.

The study included 18 volunteers, each had 2–3 relaxation trainings using 4 different biological feedback methods and recording of physiological parameters and patients' subjective opinion. The obtained measurements were examined to determine the relaxation characteristics of different types of feedback.

As a result, it was concluded that the audio-visual biofeedback was recommended to use for muscle relaxation purposes.

Keywords – Audiovisual biofeedback, biofeedback, hypertension, hypertonia, electromyography (EMG), relaxation training, upper trapezius muscle.

I. INTRODUCTION

Muscles are always partially contracted having a small degree of tension called muscle tonus or tone. Too much tone does not allow sufficient muscle rest and recovery [1].

Muscle diseases, stress and posture related muscle tension are the causes of elevated muscle tone – hypertonia.

Upper trapezius muscle is often affected by improper posture and stress related muscle tension. Continuously elevated electromyographic (EMG) activity level is considered a risk factor in developing muscle disorders, showing elevated muscle activity and inability to relax the muscle. Insufficient muscle relaxation is considered a cause of development of occupational muscle disorders [2].

Skeletal muscles are controlled by nerve impulses from a central nervous system; therefore, it is possible to consciously activate or relax muscles. The central nervous system receives information about muscle state and contraction from muscle receptors [3].

Surface electrodes placed on skin over the muscle can obtain muscle bioelectrical activities noninvasively. Electromyography (EMG) records the sum of multiple motor unit action potentials [4]. Usually, EMG recordings are obtained using a bipolar electrode configuration with a common ground electrode, which allows cancelling unwanted electrical activity from outside of the muscle. EMG is used to diagnose neuromuscular diseases, to provide deeper understanding of muscle activity and coordination mechanisms. The potential of each muscle fiber has positive and negative components. The amplitude of the signal is related to the number of triggered motor units, the power and frequency of contraction. For the amplitude analysis, a signal is rectified so that only absolute values are considered. Curve representing the muscle contraction is produced by

integrating intervals. Increased EMG amplitude shows muscle contraction, but a decrease in the amplitude indicates relaxation [5].

Relaxation training is based on something calming and awareness of the body. It is a recognised method of stress, anxiety, pain, fatigue relief and improvement of muscle control and relaxation [6].

Physiologically relaxation response can be detected as:

- decrease in muscle tension;
- increased peripheral temperature;
- slowed heart rate;
- slowed respiratory rate;
- reduced blood pressure;
- reduced sweating (reduced skin conductance);
- slowed metabolism.

Effectiveness of relaxation training can be measured by these physiological factors. It is also helpful to make patients' self-assessment questionnaire based on 11-point scale, where 0 stands for complete relaxation and 10 – maximum tension [6].

Soothing verbal commands and cognitive relaxation (visualisation) creates an overall calming effect and relaxes muscle tone [7]. In research [8], which compares the effect of slow rhythmic and fast rhythmic music on patient electromyograms, it is concluded that the slow rhythm of the music triggers the relaxation response and has a calming effect.

Biofeedback is a technique that measures bodily functions and gives you information about them in order to help control them, for example, muscle tension [9].

The use of biofeedback to see your performance improves the therapy; a patient can evaluate his progress easier without extra devices that can be physically difficult to achieve. The problem is that it may be difficult to understand and retain the interest of biofeedback if it is presented as a simple repetitive reading, such as the most commonly used electromyogram curve or simple sound signal. This means that there is a need for a method, which provides an interesting and easily perceptible biofeedback to a patient in order to improve relaxation training.

II. MATERIALS AND METHODS

The study recorded the upper trapezius muscle activity using a dual channel EMG sensor. The placement of electrodes is shown in Fig. 1.

Breathing, heart rate, skin conductance and temperature were monitored to assess the overall stress levels and relaxation response. Participants were volunteers who signed an informed

consent, if the participant was younger than eighteen, the form was signed by a guardian.

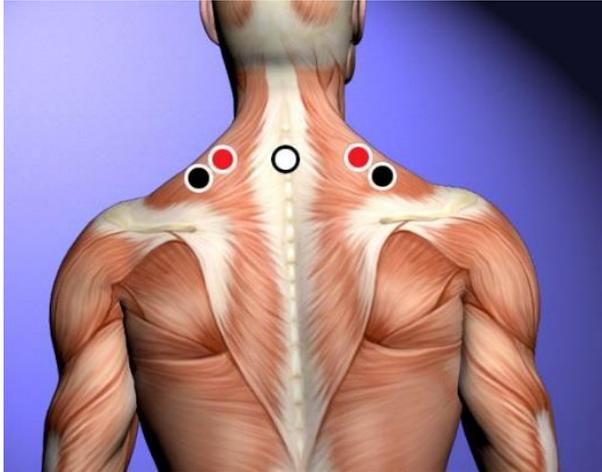


Fig. 1. Electrode placement on the upper trapezius muscle for EMG measurements [10].

A. Biofeedback Equipment

The study used physiological data acquisition and biofeedback system Nexus-10 MKII produced by MindMedia. Nexus-10 is certified as medical CE class IIa device. It is intended to use the device under supervision of or on the instructions of a physician, researcher or other authorised medical professionals, who have knowledge in physiological measurements [10].

Two monitors were used during biofeedback relaxation training, one for patient, the other for physiotherapist.

Bluetooth® transmits data from a device to a computer wirelessly. Device is provided with an active noise cancellation technology, eliminating artifacts, first by measuring external noise and subtracting it from the signal, resulting in a more accurate physiological measurement.

EMG sensor, respiration, skin conductance, temperature and heart rate sensors were used in the study.

EMG sensor is a dual-channel sensor; therefore, it can record the activity of two muscles at the same time. EMG uses surface electrodes to detect muscle action potential, which indicates muscle contraction, using one or more active electrodes. Electrophysiological signals are at the microvolt level. Ag/Cl gel electrodes are attached to the sensor and placed on the muscle to obtain measurements. Measuring electrophysiological signals always requires a ground. Therefore, ground electrode must also be attached; usually it is placed on skin over the bone.

Respiration sensor measures breathing frequency and relative depth of breathing. The sensor is embedded in an elastic belt. The sensor is placed around abdomen in a diaphragm area.

Skin conductance sensor measures a sweat gland activity on the hand. Skin conductance is measured in micro-Siemens and increases when the arousal level increases.

Temperature sensor is designed to monitor tiny temperature changes in peripheral extremities. Temperature is expressed in Celsius and can be measured from 10 to 40 °C with accuracy of 0.01 °C. The temperature sensor uses a thermistor,

which is usually placed on one of the fingers on the palmar surface. To prevent the change of temperature because of air flow, the sensor is secured by placing tape over the thermistor.

Blood volume pulse sensor is used to measure blood volume pulse and heart rate. The sensor is placed on a finger of the non-dominant hand. The movement of the sensor can cause noise artifacts; therefore, it is advisable to keep it motionless during the measurement. Measured value is heartbeats per minute in the range of 40–240 beats/minute [10].

B. Biofeedback Software

Biotrace+ is software compatible with Nexus device developed by MindMedia. The software is used for data analysis, physiological monitoring, presentation, protocol design, screen development, biofeedback sessions.

Screens with visual and audio effects for patient biofeedback training are designed using the given software. Feedback on patient screens is connected with EMG amplitude data channel. The feedback form can be chosen, for example, as video, game, animation, EMG curve, music.

10 different biofeedback relaxation training screens were created for the purpose of this trial: EMG curve, EMG curve with an audio signal and 8 audio visual screens.

- Cat animation (Fig. 2). Patient sees a sleeping cat. Patient is informed that it is possible to hear cat purring and slightly moving when muscles are relaxed (muscle tension is below the threshold). The aim is to make the cat purr as long as possible.

- Flower animation. If muscle tension increases, the flower starts closing, but when muscles are relaxed below the set threshold, the flower blossoms and relaxing music is played. The aim is to make the flower open fully.

- Butterfly video. Patient is informed that when a muscle tension threshold is above the set value, video stops and becomes smaller. When muscles are relaxed, a patient can see butterflies flying in the meadow and hear relaxing music. Music stops when muscles become tense. The aim is to achieve continuous video playback.

- Nature video. In this video, a patient can see various flowers growing and blossoming. The principle is the same as in the previous example, and the patient's aim is to achieve continuous video and melody playback, which stops when a muscle tension threshold is exceeded.

- Puzzle. Pieces of puzzle are put in the right place one by one creating a picture but only when muscles are relaxed. Additionally, the melody is played when muscles are relaxed. The aim is to solve all the puzzle.

- Sunset animation. When muscles are relaxed, a patient can hear birds chirping and see the sun rising, but tense muscles cause the sun to go down and stop the sounds. The aim is to make the sun stay up.

- Ocean animation. Patient sees an ocean animation with waves and dolphins and hears water sounds. When muscles are tensed, the animation stops and becomes smaller in size, and there is no audio sound. The aim is to achieve continuous playback of this animation.

- Waterfall animation. Patient sees a waterfall and hears the sound of falling water when muscles are relaxed. Otherwise, the

animation stops and there is no audio signal. The aim is to make the waterfall flow continuously.



Fig. 2. Biofeedback screen for patient relaxation training – Cat. Bar graphs represent the EMG amplitude of the right and left side of upper trapezius muscle and the threshold level set by a therapist.

Therapist screen (Fig. 3) is designed to be convenient to use and easily readable. There a therapist can see all attached sensor measurements in real time. Displayed signals are connected to data channels, attached to the feedback and the threshold level. Therapist can adjust a threshold level (a patient is able to see the feedback when muscle tension is below it) for each patient in the training session. The buttons are added, so it is possible to automatically open the selected biofeedback training screen on a patient's monitor, as well as to add markers with comments in order to distinguish different biofeedback screens in the data analysis.

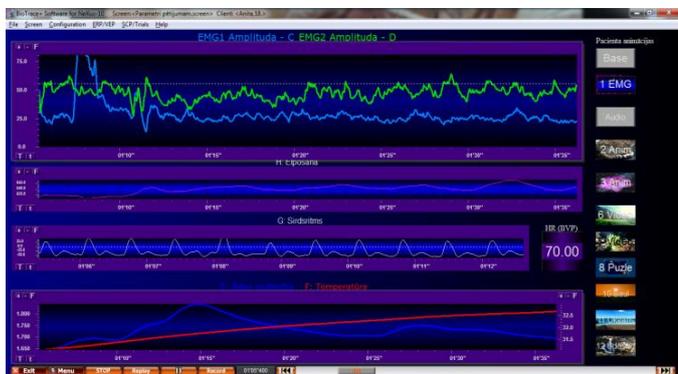


Fig. 3. Therapist biofeedback screen for relaxation training sessions. The left (D) and right (C) upper trapezius muscle EMG amplitude and the threshold set by a therapist (dotted line), respiratory movement curve (H), heart rate (G), skin conductance (E) and peripheral temperature (F) changes. Buttons at right allow switching between different relaxation screens.

C. Patient Survey

Patient was introduced to a biofeedback training process, and it was requested to sign consent for anonymous use of the obtained data for research purposes.

Patient subjectively assessed his tension level on a scale from 0 to 10, where 0 – completely relaxed and 10 – maximum tension.

Patient rated each biofeedback type according to a 5-point visual scale (Fig. 4) valuing the ease of relaxation training and interactivity. If it was very easy to relax muscles with a particular biofeedback method, it got 5 points, if easy – 4, average – 3, difficult – 2 and very difficult – 1. Interactivity is

the measurement of how much a patient liked the biofeedback method. It received 5 points if it was very interesting, 4 – interesting, 3 – average, 2 – not so much, 1 – it was not interesting.



Fig. 4. Five-point visual scale for patient survey.

D. Physiological Data Record

Patient sat comfortably in front of the monitor during relaxation training (Fig. 5), arms were resting free and legs were not crossed but positioned firmly on the ground, if necessary footrest was used. Sensors were connected to Nexus device. Physiotherapist placed sensors on a patient.

EMG sensor was placed on upper trapezius muscle as shown in Fig. 1. The distance between electrodes was 2 cm and they were positioned in the middle part of muscle in line with the fiber. The ground electrode was placed over vertebra. The skin was prepared by cleaning with alcohol before gluing electrodes. At first, disposable gel electrodes were attached to the sensor, then to a patient attaching each electrode pair to one side of upper trapezius muscle. Skin conductance, temperature, blood volume pulse sensors were attached to hand and respiration sensor was placed on abdomen.

E. Procedure

The base measurement was obtained when a patient sat still and tried to relax for about 30 seconds to 1 minute.

Then relaxation training started. Four different biofeedback relaxation screens were used: screen with EMG curve, screen with audio feedback, 2 different audio visual screens chosen by a patient in each session. Biofeedback screens were used in random sequence.

It was planned to use each biofeedback screen for 2 minutes but in reality, the time period varied, for example, due to the fact that a patient began to lose the focus, wanted to finish animation, or had already reached the aim of the animation.



Fig. 5. Relaxation training session with biofeedback.

During each session, a patient chose two audio visual biofeedback screens by selecting two images from printed screenshots. These screens were used in biofeedback relaxation training.

When training with EMG curve biofeedback, a patient was informed that curves represented the muscle tension from left and right upper trapezius, when muscles were tensed the curve went up, when relaxed – down. The aim of relaxation training was to keep it at the lowest possible level, under the threshold.

When training with audio biofeedback, the patient was informed that there would be piano tones depending on the muscle tension, when muscles were tensed the piano tone became higher and disappeared. The aim was to achieve a lower tone and hold the EMG curve below the threshold.

When training with audio-visual biofeedback, a patient was informed about the mechanism and aim of each chosen biofeedback screen.

Biofeedback was based on the threshold level. Patient was guided to keep muscle tension below the threshold. Additionally, each animation contained a bar graph, which showed the muscle tension level and biofeedback threshold. During the training session, a therapist could change the threshold level in the therapist's screen, in such a way the change was also forwarded to the patient's screen.

If it was difficult for a patient to reduce tension and the threshold was set too low, it was elevated; and reversely if the threshold was too high, the level was lowered to promote further relaxation.

III. RESULTS

A. Volunteers

18 volunteers participated in the trial. 14 participants had 3 relaxation training sessions and 4 had 2 training sessions. In total, 50 biofeedback relaxation training sessions were performed.

Participants were aged between 13 and 25 years, mean 20 years. Six participants were under the age of 18 years. There were 11 female and 7 male participants in the study.

B. The Analysis of Patient Survey Data

Subjective relaxation level was evaluated according to a 11-point scale.

Data collected by the survey are represented as boxplots (Fig. 6). The most obvious effects of relaxation training could be seen before and after the 1st session, the maximum tension level dropped from 7 to 5, the median tension decreased and there were more participants who chose a lower tension level after training session, showing relaxation.

Participant mean tension level also decreased after the 2nd and 3rd relaxation sessions. However, there were higher maximum values; it could be influenced by individual patient factors, particularly on that day.

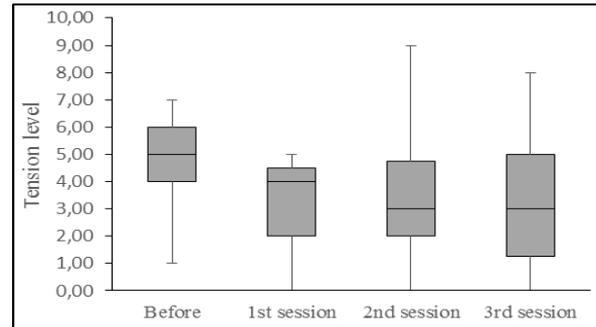


Fig. 6. Tension level subjectively decided by participants (10 – maximum tension and 0 – completely relaxed) before relaxation training, after the 1st session, after the 2nd session and after the 3rd session.

The evaluation of each type of biofeedback is shown in Table I. The mean value was estimated from all patient rated values, and standard deviation (SD) was calculated.

The most commonly chosen audio-visual biofeedback was ocean animation.

Patients evaluated the ease of relaxation similarly for EMG curve, audio and audio-visual biofeedback; the audio-visual biofeedback was evaluated slightly (0.3 points) higher. The flower animation and nature video biofeedback were rated as the easiest biofeedback (4.7 points) to practice.

Patients rated interactivity of audio-visual feedback by 0.9 points higher compared with the EMG curve and by 0.8 points higher than the audio signal biofeedback. Participants rated audio-visual biofeedback “butterfly video” and “puzzle” as the most interactive biofeedback (4.7 points).

TABLE I
THE EASE AND INTERACTIVITY OF BIOFEEDBACK RELAXATION TRAINING
EVALUATED BY PATIENTS

Biofeedback type	Number of sessions	The ease of relaxation, 5-point scale		The interactivity, 5-point scale		
		Mean	SD	Mean	SD	
1 EMG curve	50	4.1	1.2	3.6	1.3	
2 Audio	50	4.0	1.0	3.7	1.3	
3 Audio visual	100	4.4	1.0	4.5	0.9	
Audio visual	Cat animation	14	4.3	1.0	4.3	1.1
	Flower animation	10	4.7	0.6	4.6	0.7
	Butterfly video	11	4.5	0.5	4.7	0.6
	Nature video	9	4.7	0.7	4.6	0.7
	Puzzle	11	4.5	0.7	4.7	0.6
	Sunset animation	11	4.1	1.2	4.1	0.7
	Ocean animation	20	4.4	1.0	4.5	1.1
	Waterfall animation	14	4.0	1.3	4.1	1.1

C. EMG Data Analysis

Digital bandpass filter of 20–500 Hz was used for EMG recording. EMG amplitude as a root mean square (RMS) was recorded with a sample rate of 32 samples per second.

Each person has an individual control muscle tone; therefore, the evaluation of relaxation was studied separately for each person comparing a tension level and base measurement tension.

Data analysis was performed using Biotrace+ software. The mean EMG amplitude for each biofeedback type was estimated. There were two different audio visual biofeedback screens in each session; data was analysed as a combination of both.

Compared with base measurement, from a total of 50 relaxation sessions, relaxation was observed in 36 audio visual biofeedback sessions, 30 EMG curve biofeedback sessions, and 32 audio biofeedback sessions.

The greatest muscle relaxation compared to base was $59.2 \mu\text{V}$ and it happened in the 2nd session during the audio-visual biofeedback for the 8th participant as seen in Fig. 7. In the same session for EMG curve biofeedback it was $43.5 \mu\text{V}$ and audio biofeedback – $58.8 \mu\text{V}$.

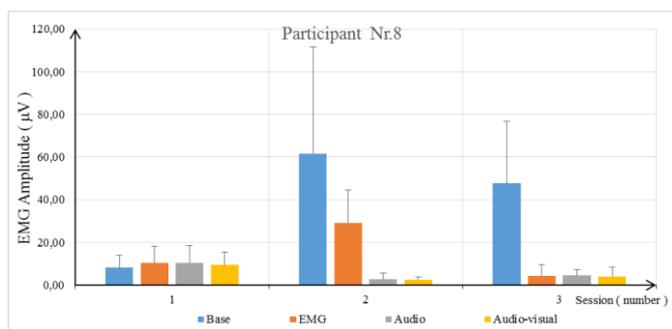


Fig. 7. Mean EMG amplitude for the 8th participant for 3 sessions, respectively for base measurement, EMG, audio and audio-visual biofeedback method.

D. Analysis of Physiological Data

Relaxation response is individual for each participant. Some physiological parameters can have a significant change but some can stay the same.

Peripheral temperature measured on the finger varies for participants; base values are ranging from 19.85 to 35.94 °C. During relaxation training the observed temperature dropped and increased. There is a common tendency for the average temperature to increase in relaxation training.

Fig. 8 shows a temperature change for the 5th participant during the relaxation session. In this case, peripheral temperature increased by 5.82 °C during audio-visual biofeedback, which indicated relaxation.

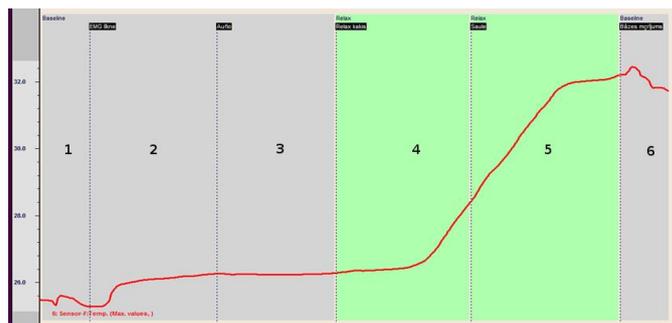


Fig. 8. Temperature curve of the 5th participant in the 1st relaxation training session (vertical axis – temperature °C and horizontal axis – time; there are 6 segments divided by vertical lines – markers, 1 – base, 2 – EMG curve BF, 3 – audio BF, 4 and 5 – audio visual BF, 6 – base).

Skin conductance increased and dropped for most participants even within a single biofeedback (BF) method. Fig. 9 shows the change in skin conductance during one relaxation training session; it is visible that the overall level of skin conductance decreases, therefore indicating relaxation.

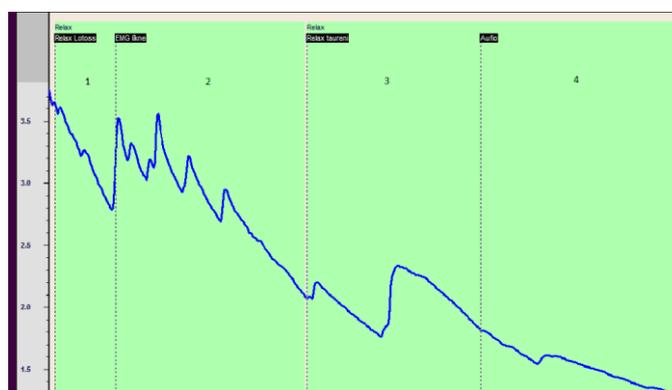


Fig. 9. Skin conductance of the 6th participant in the 2nd relaxation session (Vertical axis – μS and horizontal – time; there are 4 segments, 1 – audio visual BF, 2 – EMG curve BF, 3 – audio visual BF, 4 – audio BF).

Respiration sensor was used to monitor the regularity and pace of abdominal breathing movement.

Regular and sinusoidal breathing curve and slower breathing pace indicate relaxation. During relaxation training, patients were guided to control their breathing.

Fig. 10 shows a rhythmic breathing example achieved by a patient in biofeedback relaxation training.

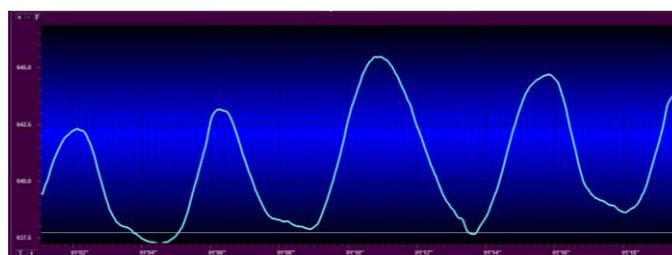


Fig. 10. Breathing curve of the 3rd participant in the 3rd relaxation training session.

Heart rate was compared with the base measurement. If the difference was greater than one beat per minute, it was considered to be a decrease in the heart rate. During the audio-visual biofeedback, the heart rate decreased in 26 relaxation sessions and was the same in 11 out of 50 relaxation sessions. For the EMG curve biofeedback, it decreased in 24 sessions and was the same in 12 sessions; and for the audio biofeedback a decrease in the heart rate was observed in 26 sessions and in 5 sessions it stayed the same.

IV. CONCLUSION

The patient survey data analysis showed that the audio-visual biofeedback was easier understandable and more interactive than the commonly used types of biofeedback (EMG curve and audio biofeedback). Patients subjectively reported a reduction in the level of tension after relaxation training sessions. It means that biofeedback can be successfully used in relaxation training.

The EMG amplitude relaxation of upper trapezius muscle was observed in 36 out of 50 training sessions when using the audio-visual biofeedback; in the EMG curve it was observed in 30 sessions and in the audio feedback it was observed in 32 sessions. However, more research is needed to ground the difference between biofeedback types making it statistically significant. To affirm that the audio-visual biofeedback has significant benefits, further research is needed with more relaxation training sessions for each patient and more patients.

The relaxation level could have been affected by the sequence of biofeedback screens, the patient's individual response, mood and external conditions.

The relaxation response physiologically is different for patients. Peripheral temperature has a tendency to increase and heart rate tends to slow down. Skin conductance varies for patients even within one relaxation session.

It can be observed that participants find the biofeedback which does not stop after certain time but requires constant attention more interesting. For developing new audio visual biofeedback screens, it is advised to use relaxing nature videos and sounds, various puzzle animations and continuously changing animations.

It is advised to use the audio-visual biofeedback for muscle relaxation training.

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REFERENCES

- [1] CNS Clinic "Muscle tone – spinal reflexes" 2007 [Online]. Available: <http://www.humanneurophysiology.com/muscltone.htm> [Accessed: April 10th, 2015].
- [2] P.Vedsted, K. Sogaard, A.K. Blangsteda, P. Madeleinec, G. Sjogaard, "Biofeedback effectiveness to reduce upper limb muscle activity during computer work is muscle specific and time pressure dependent," *Journal of Electromyography and Kinesiology*, vol. 21, no. 1, pp. 49–58, Feb. 2011. <http://dx.doi.org/10.1016/j.jelekin.2010.06.002>
- [3] A. Valtneris, *Cilvēka fizioloģija Rokasgrāmata*. Rīga: Zvaigzne ABC, 2002.
- [4] L. Aberberga – Augškalne, *Fizioloģija rehabilitologiem un veselības sporta speciālistiem*. Rīga: SIA "Medicīnas apgāds", 2008.
- [5] M. Kutz, *Biomedical engineering and design handbook second edition*, New York: McGraw-Hill, 2009.
- [6] D. Hertling, R. M. Kessler, *Management of Common Musculoskeletal Disorders Physical Therapy Principles and Methods*. 2006, USA: Lippincott Williams & Wilkins, 2006.
- [7] S. O'Sullivan, T. Schmitz, *Physical Rehabilitation fifth edition*. USA:F.A. Davis Company, 2006.
- [8] S. Kara, P. Ozel, "Determination of Effects of Different Music on Frontal Muscle by Using EMG Signal," in *Frontiers in the Convergence of Bioscience and Information Technologies, Jeju City 11-13 Oct. 2007*. pp. 449–452. <http://dx.doi.org/10.1109/FBIT.2007.36>
- [9] J.V. Campellone, "Biofeedback," in *MedlinePlus – U.S. National Library of Medicine 2013* [Online]. Available: <http://www.nlm.nih.gov/medlineplus/ency/article/002241.htm> [Accessed: May 20, 2015]
- [10] MindMedia Neuro and Biofeedback Systems [Online]. Available: <http://www.mindmedia.info> [Accessed: October 15, 2015]

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Anita Kundzina, Juris Lauznis. Audio-vizuālās bioloģiskās atgriezeniskās saites ietekme uz muskuļu relaksāciju

Rakstā apskatīta audio-vizuālās bioloģiskās atgriezeniskās saites ietekme uz pacienta spēju kontrolēt savu muskuļu saspringumu, tos relaksējot, šajā gadījumā – augšējo trapecveida muskuli.

Pētījumā piedalījās 18 brīvprātīgie, katram veiktas 2–3 relaksācijas nodarbības (kopā 50 relaksācijas nodarbības). Katrā izmantotas 4 dažādas bioloģiskās atgriezeniskās saites – EMG līkne, EMG līkne ar audio signālu, divas audio-vizuālas, tās katrā nodarbībā izvēlas dalībnieks. Relaksācijas nodarbībām kopā izstrādāti 8 dažādi audio-vizuālie atgriezeniskās saites ekrāni. Pētījumā izmantota bioloģiskās atgriezeniskās saites sistēma "Nexus-10".

Tiek veikti fizioloģiskos parametru (perifērā temperatūra, sirds ritms, ādas vadāmība, elpošanas kustības, muskuļu saspringums) ieraksts un noteikts subjektīvais pacienta viedoklis. Iegūtie mērījumi izpētīti, nosakot relaksācijas pazīmes dažādiem atgriezeniskās saites veidiem. Vadoties pēc dalībnieku aptaujas datiem, audio-vizuālā bioloģiskā atgriezeniskā saite ir vieglāk uztverama un interesantāka nekā tipiskā EMG līkne vai līkne ar audio signālu.

Rezultātā izstrādātas rekomendācijas audio-vizuālas bioloģiskās atgriezeniskās saites izmantošanai relaksācijas treniņiem. Augšējās trapeces muskuļa relaksācija (EMG amplitūdas samazināšanās) bija vērojama 36 no 50 nodarbībās audio-vizuālās saites gadījumā, EMG līknei tā bija vērojama 30 no 50 nodarbībās un līknei ar audio signālu – 32 no 50 nodarbībās. Relaksācijas līmeni varēja ietekmēt atgriezenisko saišu izpildes secība, pacienta individuālā reakcija, noskaņojums, ārējie apstākļi. Lai pilnīgi droši apgalvotu, ka audio-vizuālajai saitei ir ievērojamas priekšrocības, ir jāveic papildus pētījumi ilgākā laika posmā un lielākam pacientu daudzumam.

Audio-vizuālu bioloģisko atgriezenisko saiti ir ieteicams izmantot muskuļu relaksācijas veicināšanai.

Анита Кундзиня, Юрис Лаузнис. Влияние аудиовизуальной биообратной связи на расслабление мышц

В настоящей статье рассмотрено влияние аудиовизуального эффекта биообратной связи на способность пациента контролировать свое мышечное напряжение, расслабляя в данном случае верхнюю трапецидальную мышцу.

В исследовании участвовало 18 добровольцев, с каждым из которых было проведено 2 – 3 сеанса релаксации (в общей сложности 50 сеансов). В каждом из сеансов использовались 4 различных варианта биообратной связи: ЭМГ- кривая, ЭМГ кривая с аудиосигналом и две разные аудиовизуальные связи, которые для каждого сеанса доброволец выбирал самостоятельно. Всего для занятий было разработано 8 различных аудиовизуальных экранов обратной связи. В исследовании использовалась система биологической обратной связи Nexus-10.

Было измерены физиологические параметры (периферическая температура, сердечный ритм, частота дыхания, напряжение мышц), а также субъективное мнение пациента. В процессе исследования полученных измерений, установлены признаки релаксации от различных типов биообратной связи. По мнению участников опроса, аудиовизуальная биологическая обратная связь является более легко ощутимой и эффективной, чем типичная ЭМГ-кривая или кривая с аудиосигналом.

В результате были подготовлены рекомендации по использованию аудиовизуальной биообратной связи для использования в сеансах релаксации. Релаксация (ЭМГ огибающая по амплитуде) верхних мышц трапеции наблюдалась в течение 36 из 50 сеансов аудиовизуальной связи, кривая ЭМГ наблюдалась в течение 30 из 50 сеансах, а с аудиосигналом – в течение 32 из 50 сеансов. На уровень релаксации могла повлиять последовательность выполнения обратной связи, индивидуальная реакция пациента, настроение, а также внешние факторы. Чтобы полностью уверенно утверждать, что аудиовизуальная биообратная связь имеет значительное преимущество, необходимо проводить дальнейшие исследования в долгосрочной перспективе и на большем количестве пациентов.

Аудиовизуальную биообратную связь рекомендуется использовать для тренировок по расслаблению мышц.