

Applied Psychophysiology For Therapeutic Use: Healing A Shoulder Injury

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Abstract: *This case report describes an indirect approach incorporating diaphragmatic breathing, imagery, role rehearsal and surface electromyographic (SEMG) feedback to successfully reduce pain and increase left shoulder mobility in a 23 year old woman with a left pectoralis muscle injury from a skiing accident. It demonstrates how direct biofeedback or therapeutic interventions may be counter-productive and indirect approaches guided by SEMG activity may facilitate clinical success. Discussed are specific concepts, rationales and strategies employed that guided the successful therapeutic intervention. It is offered as a model to increase therapeutic efficacy when an initial biofeedback intervention appears not to work.*

The client T., aged 23, was a student who participated in an educational workshop for Healthy Computing. She volunteered to be a subject for a surface electromyographic (SEMG) monitoring and feedback demonstration. Ten days prior to this workshop, she had a severe skiing accident.

Assessment

Observation and Palpation

T.'s left shoulder was rolled forward (adducted and in internal rotation). She was not able to breathe or laugh without pain or move her arm freely. All movements in vertical and horizontal directions and rotations were restricted by at least 50% as compared to her right arm (limitations in shoulder extension, flexion and external rotation). Also, her hands were ice-cold and she breathed very shallowly and rapidly in her chest. She was not able to stand in an upright position or sit in a comfortable position without maintaining her left upper extremity in a protected position. Her left shoulder blade (scapula) was winging.

After visually observing her, the therapist placed his left hand on her left shoulder and pectoralis muscles and his right hand on the back of her shoulder. Using palpation and anchoring her back with his leg so that she could not rotate her trunk, he explored the existing range of shoulder movement. He also attempted to rotate the left shoulder outward and back by very gentle traction. No change in mobility was observed and the pectoralis muscle felt tight (SEMG monitoring is helpful during such a diagnostic assessment by helping to identify the person's reactivity and avoiding to evoke and condition even more bracing). T. reported afterwards that she was very scared by this assessment because there was one point in the back which was highly reactive to touch. T. appeared to tighten automatically out of fear and trigger a general flexor contraction pattern — a process that commonly occurs if a person is guarding an area.

Often a traumatic injury first induces a general shock that triggers an automatic freeze and fear reaction. Therefore, an intervention needed to be developed that did not trigger vigi-

lance or fear and thereby allowed the muscle to relax. If pain is experienced or increased, it is another negative reinforcement for generalizing guarding and bracing of the muscles. This guarding decreases mobility. T.'s vigilance was also "telegraphed" to the therapist by her cold hands and shallow chest breathing. Therefore, it was important to increase her comfort level and to not induce further pain. We hypothesized that only if she felt safe it would be possible for her muscle tension to decrease and thereby increase her mobility.

Underlying concept: The cold hands and shallow breathing probably indicated excessive vigilance and arousal — a possible indicator of a catabolic state that could limit regeneration. The chronic cold hands most likely implied that she was very sensitive to other people's emotions and continuously searches the environment for threats. In addition, she indicated that she liked to do her best which induced more anxiety and fear of judgement.

Single Channel Surface Electromyographic Assessment

The electrode was placed over the left pectoralis muscle area. The equipment was a small portable SEMG with the preamplifiers at the triode sensor to eliminate electrode lead and movement artefacts. The SEMG unit was placed within view, so that the therapist and the subject could see the visual feedback signal and observe what was going on as well as demonstrate expected changes. The feedback was used for T. as a tool to see if she could reduce her SEMG activity. It was also used by the therapist to guide his interventions: To keep the SEMG activity low and to stop any intervention that would increase the SEMG activity as this would prevent bracing as a possible reaction to, or anticipation of, pain.

1. Assessment of Muscle Reactivity. After the electrode was attached on her pectoralis muscle and with her arm resting on her lap, she was asked to roll her left shoulder slightly more forward, hold the tension for the count of 10 and then let go and relax. Even with feedback, the muscle activity stayed high and did not relax and return to a lower level of activity. This lack of return to baseline is often a diagnostic indicator of muscle irritability or injury (Sella, 1998; Sella & Donaldson, 1998). If the muscle does not relax immediately after contraction, movement or exercise should not be prescribed, since it may aggravate the injury. Instead, the person first needs to learn to relax and then learn how to relax between activation and tensing of the muscle. The general observation of T. was that at the initiation of any movement (active or passive) muscle tension increased and did not return to baseline for more than two minutes.

2. Exploration. Self-exploration with feedback was encouraged. T. was instructed to let go of muscle tension in her left

shoulder girdle. In addition the therapist tried to induce her letting go by gently and passively rocking her left arm. The increased SEMG activity and the protective bracing in her shoulder showed that she couldn't reduce the muscle tension. Each time her arm was moved, however slightly, she helped with the movement and kept control. In addition, T. was asked to reduce the muscle tension using the biofeedback signal; again she was not able to reduce her muscle tension with feedback.

3. Passive Stretch and Movements. The next step was to passively stretch the pectoralis muscle by holding the shoulder between both hands and very gently externally rotate the shoulder — a process derived from the Alexander technique (Barlow, 1990). Each time the therapist attempted to rotate the shoulder, the SEMG increased and T. reported an increased fear of pain. T.'s SEMG response most likely consisted of the following components: Movement induced pain; Increased splinting and guarding; Increased arousal/vigilance to perform well.

These three assessment and self-regulation procedures were unsuccessful in reducing muscle tension or increasing shoulder movement. This suggested that another therapeutic intervention would need to be developed to allow the left pectoralis area to relax. The SEMG could be used as an indicator whether the intervention was successful as indicated by a reduction in SEMG activity. Finally, the inability to relax after tightening (bracing and splinting) probably aggravated her discomfort.

Multiple levels of injury: The obvious injury and discomfort was due to her left chest wall being hit by the ski pole. She then guarded the area by bracing the muscles to protect it, which limited movement. The guarding tightened the muscles and limited blood circulation and lymphatic flow which increased local ischemia, irritation and pain. This led to a self-perpetuating cycle: *Pain triggers guarding and guarding increases pain and impedes self-healing.*

As the SEMG and passive stretching assessment were performed, the therapist concurrently discussed the pain process. Namely, from this perspective, there were at least two types of pains:

- Pain caused by the physiological injury
- Pain as the result of guarding

The pain from the guarding is similar to having exercised for a long time after not having exercised. The next day you feel sore. However, if you feel sore, you know that it was due to the exercise therefore it is defined as a good pain. In T.'s case, the pain indicated that something was wrong and did not heal and therefore she would need to protect it. We discussed this process as a way to use cognitive reframing to change her attitude toward guarding and pain.

Rationale: The intention was to interrupt her negative image of pain that acted as a post hypnotic suggestion. The objective was to change her image and thoughts from "pain indicates the muscle is damaged" to "pain indicates the muscle has worked too hard and long and needs time to regenerate."

Treatment Intervention

The initial intervention focused upon shifting shallow thoracic breathing to diaphragmatic breathing. Generally, when

people breathe rapidly and predominantly in their chest, they usually tighten their neck and shoulder muscles during inhalation. One of the reasons T. breathed in her chest was that her clothing — very tight jeans — constricted her waist (MacHose & Peper, 1991). This breathing pattern probably contributed to sub-clinical hyperventilation and was part of a fear or flexor response pattern. When she loosened the upper buttons of her jeans and allowed her stomach to expand her pectoralis muscle relaxed as she breathed. As she began to breathe in this pattern, each time she exhaled her pectoralis muscle tension decreased.

Following the demonstration that breathing significantly lowered her chest muscle tension, the discussion focused on the importance of effortless diaphragmatic breathing for health and reduction of vigilance. Being awkward and uncomfortable at loosening her pants, she struggled with allowing her abdomen to expand and her pants to be looser because she thought that she looked much more attractive in tight clothing. Yet, she agreed that her boy friend would love her regardless whether she wore loose or tight clothing. To encourage an acceptance for wearing looser clothing and thereby permit diaphragmatic breathing during the day, an informal discussion focused on "designer jeans syndrome" (chest breathing induced by tight clothing) with humorous examples such as discussing the name of the room that is located on top of the stairs in the Victorian houses in San Francisco. It is called the fainting room — in the 19th century women who wore corsets and had to climb the stairs would have to breathe rapidly and then would faint when they reached the top of the stairs (Peper, 1990).

Rationale: Rapid shallow chest breathing can induce a catabolic state that inhibits healing while diaphragmatic breathing may induce an anabolic state that promotes regeneration. Moreover, effortless diaphragmatic breathing would increase respiratory sinus arrhythmia (RSA) — heart rate variability linked to breathing — and thereby facilitate sympathetic-parasympathetic balance that would promote self-healing.

The discussion included the use of the YES set which means asking a person questions in such a way that they have to answer the question with YES. Often when a person answers YES at least three times in a row rapport is facilitated (Erikson, 1983, pp. 237-238). Questions were framed in such a way that the client would answer with YES. In T.'s case, the therapist said, "I see, you would rather wear tight clothing than allow your shoulder to heal." She answered, "Yes." This was the expected answer, however, the question was framed in an intuitive guess on the therapist's part. Nevertheless, the strategy would have been successful either way because if she had answered "No," it would have broken the "Yes: set, but she would then be committed to change her clothing.

Throughout this discussion, the therapist placed his left hand on her abdomen over her belly button and overtly and covertly guided her breathing movement. As she exhaled, he pressed gently on her abdomen; as she inhaled he drew his hand away. To enhance learning diaphragmatic breathing and slower exhalation, the therapist covertly breathed at the same rhythm and gently exhaled as she exhaled while allow-

ing the breathing movement to be mainly in his abdomen. In this process, learning occurred without demand for performance and T. could imitate the breathing process that was covertly modelled by the therapist.

The Change

The central observation was that each time she tried to relax or do something, she would anticipate and increase her pectoralis SEMG activity. The chronic tension from guarding probably induced localized ischemia, inhibited lymphatic flow and drainage, and reduced blood circulation, which would increase tissue irritation. Whenever the therapist began to move her arm, she would try to help with the movement. Overall she was vigilant and wanted to perform very well. Her muscle bracing and helping with movement was reframed as a combined activity that consisted of guarding to prevent further injury and as a compliment that she would like to perform well. Labelling her activity as a “compliment” was part of a continuing YES set approach. The therapist deliberately framed whatever happened as adaptive behaviour, with positive intent. The challenge was how to reduce vigilance, perfectionism and guarding so that the muscles would relax.

Therapeutic concept: If a direct approach does not work, an indirect approach needs to be employed. Through an indirect approach, the person experiences a change without trying to focus on doing or achieving it. Underlying this approach is the guideline: *If something does not work, try it once more and then if it does not work, do something completely different.*

The shift to an indirect intervention was done through visualization. T. was encouraged to visualize a positive image or memory from her past. She chose a time when she was in Paris with her grandmother. While T. visualized being with her grandmother, an older woman participant held T’s right hand in a grandmother-like way. The “grandmother” then moved T.’s hand in a playful way as if dancing with T.’s right arm. Through this kinesthetic experience, T. became absorbed in her memory experience. At the same time, T’s left hand was being held and gently rocked by the therapist. During this gentle rocking, the SEMG activity decreased completely in her left pectoralis area. The therapist used SEMG feedback to guide him in the gentle rocking motion of T.’s left arm and very slowly increased the range of her arm and shoulder motion. It allowed the muscle to stay relaxed and facilitated the experience of trust.

Rationale: Every corresponding thought and emotion has an associated body response and every body response has an associated mental/emotional response. Therefore, an image and experience of a happy and safe past memory will allow the body to evoke the same state, and vigilance can be abated. The intensity of the experience is increased when multi-sensory cues are included. The more senses are involved, the more the experience can become real. In addition, the tactile sensation of feeling the grandmother’s hand diverted her attention away from her shoulder and reduced her active efforts of trying to relax the shoulder and pectoralis area.

SEMG feedback was used as the guide for controlling the movement. The therapist gently increased the range of the movements in abduction and external rotation directions

while continuously rocking her arm until her injured arm was able to move unrestricted in full range of motion. The arm and shoulder relaxation and continuous subtle movement without evoking any SEMG activation facilitated blood flow and lymphatic drainage, which probably reduced congestion. After a few minutes, the therapist gently dropped her arm on her lap. After her arm was resting on her lap, she reported that it felt very heavy and relaxed and that she didn’t feel any pain.

To deepen and generalize the relaxation and breathing, she was asked to imagine breathing the air down and through her arms and legs — a strategy that she could then do at home with her boyfriend. We wanted to involve another person because it is often difficult to do homework practices without striving and concern for results and focusing on the area of discomfort. We role-played how her boyfriend was to encourage diaphragmatic breathing. Then, while she continued to breathe effortlessly, he would gently rock and move her arm.

RESULTS

She left the initial session without any pain and with total range of motion. At the two week follow-up she reported continued pain relief and complete range of motion. The physiological assessment three weeks later included monitoring thoracic and abdominal breathing patterns, blood volume pulse, heart rate and SEMG from her left pectoralis muscle while she was asked to roll her left shoulder forward for the count of 10 and then relax. The physiological recording showed that she breathed more diaphragmatically and that her pectoralis muscle relaxed and returned directly to baseline after rotation.

Summary

This case example demonstrates the usefulness of a simple one-channel SEMG biofeedback device to guide the interventions during assessment and treatment. It suggests that the therapist and client can use the SEMG activity as an indicator of guarding — a visual representation of the subjective experience of fear, pain and range of mobility — that can be evoked during assessment and therapeutic interventions. The anticipation of increased pain commonly occurs during diagnosis and treatment and often becomes an obstacle for healing because increased pain may increase anticipation of pain and trigger even more bracing. To avoid triggering this vicious circle of guarding/fear, the feedback signal allows the therapist and the client to explore strategies that reduce muscle activity by indirect interventions.

By using an indirect approach that the client may not expect, the interventions shift the focus of attention and striving and may allow increased relaxation. The biofeedback signal may guide the therapeutic process to reduce the patterns of fear and bracing that are commonly associated with injury and illnesses. Once this sympathetic activity is reduced, the actual pathophysiology may become obvious and the healing process may be accelerated. This case description may offer an approach in diagnosis and treatment for many therapists and open a door for a gentle, painless and yet successful way of treatment and encourage therapists to be creative and use both technique and intuition. (*footnotes available upon request*)

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