Facial Neuromuscular Retraining

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Facial nerve paresis can result from conditions like Bell's palsy, herpes zoster, tumors, facial trauma, otitis media, post-surgical trauma, and congenital disorders. Facial nerve dysfunction can lead to problems with physical function, such as excessive tearing of the affected eye, drooling, and difficulties with speech, eating, and drinking. As physical appearance and nonverbal facial expressions can be affected, the psychological effects can be profound (Brach, VanSwear-ingen, Delitto, & Johnson, 1997).

Synkinesis and weakness can be disturbing sequelae of facial nerve paresis. Synkinesis is defined as involuntary muscle contractions accompanying intended movement (Brach, VanSwearingen, Delitto et al., 1997). Examples of synkinesis are involuntary eye closure associated with lip pucker or involuntary cheek muscle contraction with eye closure.

Facial neuromuscular retraining is a treatment approach based on a comprehensive assessment of a patient's facial nerve function. Treatment is delivered by physical therapists, occupational therapists, and/or speech-language pathologists who have been specially trained (Diels, 1995). The goal of neuromuscular retraining is to improve symmetry of facial expression and inhibit involuntary muscle contractions. Rehabilitation of abnormal facial movements is based on the concept of neural plasticity, whereby the central nervous system learns to use the recovered facial nerve more appropriately (Balliet, Shinn, & Bach-Y-Rita, 1982; Cronin & Steenerson, 2003).

The purpose of this paper is to provide an overview of facial neuromuscular retraining from a clinician's perspective, incorporating the research findings and aspects of the clinical assessment and treatment.

Research

Facial neuromuscular retraining has been found to be effective in diminishing the effects of synkinesia and improving voluntary movement. In 1982, Balliet and colleagues described a clinical program for facial nerve retraining that included mirror exercises, electromyography (EMG) biofeedback, and personalized home exercise programs for patients more than 2 years after facial nerve injury. Case reports demonstrated improvements in facial function.

Ross, Nedzelski, and McLean (1991) conducted a prospective controlled trial, randomly assigning patients with long-standing facial nerve paresis to one of two treatment groups: EMG biofeedback with mirror training or mirror training alone. A group of individuals living in a rural community served as a control. After one year of treatment, both treatment groups were found to have made statistically significant improvements with respect to symmetry of voluntary movement and linear measurements of facial expressions. The control group showed no significant changes.

Segal, Hunter, Danys, Freedman, and Black (1995) randomly assigned patients to two treatment groups: specific action exercises stopping when synkinesis occurs and specific action exercises stopping prior to synkinesis. Facial movements in both groups were found to be significantly more symmetrical after treatment.

Brach, VanSwearingen, Lenert and Johnson (1997) reported on 14 patients with unilateral facial nerve paresis in a single treatment group, pre- and post-test design. Treatment consisted of specific retraining exercise strategies in conjunction with EMG biofeedback and a home exercise program, combining movement control exercises, self-stretching, and massages techniques. Quantitative video facial position analysis was carried out. After treatment, synkinesis was found to be diminished.

VanSwearingen and Brach (2003) in a follow-up study, reported on 66 patients who were referred for facial nerve retraining. A reduction in synkinesis and an increase in intended facial movements were demonstrated.

Beurskens and Heymans (2003) conducted a randomized controlled study to evaluate the effect of mime therapy, a form of facial neuromuscular retraining, on patients with longstanding facial nerve paresis. Improvements were seen in facial mobility, lip mobility, and social and physical aspects of facial disability.

Assessment

History

A patient history reviews the mode of onset of the facial nerve dysfunction (insidious, traumatic, etc.) and the clinical course. The beginning of facial movement recovery and clinical course can be correlated to the likely degree of nerve injury. A mild nerve injury can start to improve in a matter of days to a few weeks. More significant nerve injury involves axonal and possibly endoneurial tube damage. Reinnervation can occur over a 3- to 12-month time period (Balliet, 1989).

A detailed enquiry about the patient's current status could include the following:

- His or her main complaint
- Reports of discomfort and/or muscular tightness or stiffness
- Sensory changes
- Hearing changes (hyperacusis, tinnitus, or loss of hearing)
- Eye lacrimation (dryness or excessive tearing)

- Eye care (drops, ointment, patch, or taping)
- Oral problems (drooling, difficulty with eating, drinking, and speaking).

Muscle Resting Tone

A detailed clinical examination starts with observation of the resting tone of the facial musculature, comparing the involved side to the uninvolved side. Altered muscle activity can change the resting symmetry of the features of the face (Diels, 1995). Paralyzed or weakened facial musculature may appear flaccid and drooped. Facial lines may be absent, decreased or lowered. For instance, if the frontalis musculature is paralyzed, forehead wrinkles may be absent with the eyebrow drooped.

Facial musculature that experiences involuntary muscle contractions (synkinesis) will develop increased resting muscle tone. Heightened muscle tone will produce more pronounced facial lines and/or the appearance that the muscles are partially contracting at rest. The eye may appear narrowed or the corner of the mouth may be pulled up or out (Diels, 1995).

Observation of resting muscle tone, comparing involved side to the uninvolved side, may include the following:

- Brow (drooped, elevated, or symmetrical)
- Eye (narrowed, wide, or symmetrical)
- Nasolabial fold (absent, less or more pronounced, or symmetrical)
- Corner of mouth (drooped, pulled up/out, or symmetrical)
- Chin (asymmetrical lines or dimples or symmetrical)

(Balliet, 1989)

Voluntary Movement

Assessment of facial movement includes observation of voluntary facial expressions. An estimate of the amount of voluntary movement can be scored on a scale from 0 to 100%, based on the excursion of the movement and the degree of symmetry, as compared to the unin-volved side. Descriptive comments for each movement are also recorded. The following is a list of standard facial expressions that can be assessed:

- Forehead elevation
- Frown (observing the eyebrow movement)
- Closed mouth smile
- Open mouth smile
- Smirk (moving one corner of the mouth laterally)
- Snarl (lifting the upper lip revealing the teeth)
- Lip compression
- Pucker
- Lip protrusion (flaring lips forward and outward)
- Pout (lower lip moving forward)
- Lip corners down

(Balliet, 1989)

Synkinesis, the involuntary movement(s) associated with the voluntary facial expressions, is also observed. The amount of synkinesis that would occur with the above movements can be graded on a scale of 0 to 3: 0 – none, 1 – mild, 2 – moderate, 3 – severe. The specific facial muscles that experience these involuntary contractions are listed and graded (Coulson & Croxon, 1995; Ross, Fradet, & Nedzelski, 1996).

Eye closure can easily be measured using a linear measurement. If the eye does not close completely, the amount of opening can be recorded in millimeters. The presence of the Bell's reflex is also noted. Bell's reflex is a normal protective reflex whereby the eyeball rolls upward behind the eyelid when the eye does not completely close (Balliet, 1989). Any synkinesia present can be graded as above.

Videotape

Videotape evaluation is an excellent means of assessing sequential movement (both voluntary and spontaneous) and observing change over time. A suggested protocol has been described elsewhere (Diels & Coombs, 1997).

Outcome measures

Clinical examination can be strengthened by the use of standardized assessment tools that have been found to be valid and reliable. The Sunnybrook Facial Grading Scale, an impairment measure, and the Facial Disability Index, a disability measure, have proven psychometric properties.

The Sunnybrook Facial Grading System (SB FGS) is an impairment measure used extensively by facial retraining therapists, as well as other health care professionals. The SB FGS incorporates three clinically important components—facial resting symmetry, symmetry of voluntary movement, and synkinesis. A composite score is obtained, with normal facial function measuring 100 and complete facial paralysis measuring 0 (Ross et al., 1996). Reliability and validity of this tool have been shown by many investigators, and the system has been shown to be responsive to clinically important change over time (Beurskens, Munyan, Hankel, & Oostendorp, 2004; Brach, VanSwearingen, Lenert, et al., 1997; Kayhan, Zurakowski, & Rauch, 2000; Ross et al., 1996).

The Facial Disability Index (FDI) is a disease-specific self-report questionnaire that measures disability for patients with facial nerve involvement. Two subscales— physical function and social/well-being—are obtained. The subscale scores range from 0 to 100. A score of 100 indicates normal function. The FDI is easy to apply and score. This measure has proven reliability and construct validity (VanSwear-ingen & Brach, 1996).

The House-Brackmann Facial Nerve Grading System (House & Brackmann, 1985) is widely used by physicians and frequently reported in the literature. It classifies facial nerve function into six possible grades. It is easy to use, classifying patients into general categories. It is a quick tool that serves the needs of physicians well, but it does not detect subtle clinical changes, rendering it less useful for the rehabilitation professional (Coulson & Croxon, 1995; Ross et al., 1996).

Indications for retraining

There must be evidence of sufficient facial nerve reinnervation before retraining can take place; therefore, voluntary movement must be present. Additionally, the time frame since onset is to be considered. Because approximately 70% of Bell's palsy cases recover completely within 3 months (Peitersen, 2002), it is advisable to defer intensive neuromuscular retraining until this time period has passed (Diels, 1995).

Onset of synkinesia is another indication to begin facial retraining. Synkinesia will not resolve spontaneously and has been found to diminish with treatment. There is no time limit from the onset of the facial nerve injury for rehabilitation to be considered. Patients many years later may still benefit from retraining (Diels, 1995; Ross et al., 1991). Evidence of muscle hyperactivity on the uninvolved side of face is another indication for therapeutic intervention.

Patient management in acute stage

Education is the most important component of treatment in the early stages of facial nerve paresis and may include the following:

- Expected time frames for nerve healing and muscle reinnervation and possible patterns of recovery are explained (Coulson & Croxon, 1994). Frequently, changes in the resting tone of the face will begin to improve before voluntary muscle contractions are visible.
- Basic facial anatomy and muscle kinesiology are taught. A diagram of the facial musculature is a helpful tool (Balliet et al., 1982).
- The appropriate time to begin exercise is reviewed. All patients are extensively educated about the risks of performing inappropriate facial exercises. When a complete paralysis is present, gross, nonspecific and maximal effort exercises will involve exclusively the uninvolved side of the face. This can lead to hyperactivity of the uninvolved side. As reinnervation begins, nonspecific, maximal effort exercise still favors the uninvolved side contributing to the muscle imbalance between the two sides of the face. A hyperactive uninvolved side puts a newly recovering weak side at disadvantage (Diels, 1995).
- If hyperactivity of the uninvolved side of the face has developed, relaxation techniques for the facial musculature can be taught.
- Eye care as prescribed by the patient's physician is reinforced. This may include the application of eye drops and/or ointment and the use of an eye patch or taping the eye closed at night. When eye closure is incomplete and lacrimation is faulty, there is a risk of developing exposure keratitis of the cornea.
- Gentle massage and tapping of the facial musculature with the fingertips by the patient may be helpful. It is thought to promote the blood circulation, improve sensory stimulation and increase the patient's awareness of his face (Coulson & Croxon, 1994).

Retraining during the initial recovery

Once voluntary facial muscle contractions appear, it is appropriate to commence retraining. Slow, gentle movements that are symmetrical are recommended. This allows the patient to practice the best possible repetitions, without the stronger, uninvolved side of the face overpowering the weak side. The patient is instructed to perform the exercises in front of a mirror to ensure good quality of movement (Coulson & Croxon, 1994; Diels, 1995). Visualizing the desired movement prior to starting can promote muscle recruitment.

The patient can also be taught to use various facilitation techniques to assist weak muscles. A quick stretch applied immediately before a movement can be helpful. For instance, a quick downward stretch to the frontalis muscle can assist forehead elevation. Automatic reflex actions, such as sniffing, may stimulate the levator muscle group to begin the lift of the nasolabial fold required for the snarl exercise. Gentle manual assistance to a movement is another beneficial technique. The clinician will assess the effectiveness of all of these strategies for the different muscle groups and advise the patient accordingly.

When eye closure is weak and the Bell's reflex is present (eyeball rolling upward), a patient often mistakenly thinks that his eyelid is completely closed. As the eyeball rolls upward during eye closure, the patient no longer sees anything. The patient gets the incorrect impression of full eye closure (Balliet, 1989).

Eye closure retraining is a treatment priority and needs to consider the Bell's reflex. To retrain the orbicularis oculi musculature, the patient is instructed to direct his or her gaze downward at a given target while trying to close his or her eyes. Generally, more eye closure is achieved while looking downward, as the Bell's reflex is temporarily inhibited. The orbicularis oculi musculature is

given the opportunity to contract further into its range. If full eye closure is not obtained, the patient can be instructed in the use of a mirror. A hand mirror is held in the patient's lap or at chest level. He or she is asked to maintain eye position by looking at the pupil of his eye, while attempting eye closure (Balliet, 1989). If full eye closure still is not achieved, the patient can manually assist the remainder of the movement. The patient is instructed to try to maintain the full eye closure once the manual assistance is removed. The patient then tries to open the eyes slowly, as there is often a tendency for the eyes to open quickly.

The patient is instructed to practice the facial exercises at home on a daily basis. Once the patient demonstrates an understanding of how to perform the exercise program, he/she can be monitored on a monthly basis. On follow-up, exercises can be modified, as necessary. The clinician can also assess the patient for the development of synkinesis (Diels, 1995).

Retraining for synkinesis

As facial nerve reinnervation continues, recovery may be impeded by the development of synkinesis, the unwanted movements associated with various facial expressions. Examples of synkinesis are involuntary eye closure associated with smiling or involuntary cheek muscle contraction with eye closure. As a result of these involuntary muscle contractions, the resting tone of these muscles increases. This often produces feelings of stiffness or tightness in the facial muscles. Many patients report aching or cramping sensations. Synkinesia may cause facial lines to deepen and the muscles to appear partially contracted at rest. There are two important components of treatment: relaxation techniques, to normalize increased muscle tone, and neuromuscular retraining, to improve voluntary muscle control and inhibit synkinesis (Diels, 1995).

Relaxation techniques

Various authors report the following to be beneficial (Balliet et al., 1982; Coulson & Croxon, 1994; Diels, 1995).

- Application of heat
- Self-massage and face tapping
- Sustained manual stretching to the involved musculature
- General body relaxation with an emphasis on the head and neck region. As the patient becomes skilled in achieving muscle relaxation, he or she is cued to recognize increasing muscle tension and incorporate this technique into his or her day

Neuromuscular retraining

Exercises are slow, gentle, and symmetrical movements with a focus on inhibiting the involuntary muscle contractions. The patient receives visual feedback with the use of a mirror. The clinician provides verbal feedback, cuing the patient to the presence of the synkinesis. The patient is instructed to slowly perform the desired movement and to stop the movement before the involuntary muscle contractions in another part of the face begin. For instance, for eye muscle synkinesis with a closed mouth smile, the patient would be taught to practice a small, balanced smile, stopping before any involuntary muscle contractions around the eye begin (Segal et al., 1995). More difficult to execute, but also effective, is attempting to perform the desired movement to the point of onset of synkinesis and then relaxing the involuntary muscle contractions. For example, for eye synkinesis with lip pucker, the patient would be asked to move the lips forward until slight involuntary movements of the eye muscle begins. He or she maintains the lips in this position while an attempt is made to decrease the eye muscle activity. This effort requires significant concentration on the part of the patient (Diels & Coombs, 1997).

EMG Biofeedback is a very useful modality to assist in the reduction of synkinesis. It can be an effective means of learning muscle relaxation and can provide feedback to the patient on how best to minimize involuntary muscle contractions during exercise (Coulson & Croxon, 1994).

Patient motivation and sense of responsibility must be very high, as the vast majority of the exercise program is done at home. The patient often has numerous exercises to perform. Patients frequently state that the effort required for facial nerve retraining is more mental than physical. Precision and slow speed are essential components of effective practice (Diels, 1995). Visualization of the facial musculature, imagining that the different parts of the face are separate, can facilitate retraining.

Meaningful repetition of the retraining movements over time is necessary to cause lasting change. Patients typically can spend 30 minutes daily on their home exercise program. Patients' participation in facial neuromuscular retraining frequently ranges from one to 2 years, as changes occur very slowly. Patients may initially attend therapy every few weeks while learning their exercise program. For patients living at a distance to the clinician, longer, more intensive initial sessions may work best. Once the patient demonstrates proficiency with the exercise program, follow-up sessions can be scheduled less frequently. The timing of reassessments can range from monthly to every 2 to 3 months depending on where the patient lives (Diels, 1995). Patient compliance seems to be positively effected by regular follow-up with the facial nerve therapist.

Over time the exercises become easier to perform. The synkinesis is delayed and the amount diminishes. These effects are seen very gradually with spontaneous movement (Diels, 1995). As synkinesis decreases, muscle tone becomes more normal. Improvements are noted in complaints of muscle stiffness and discomfort. The quality and quantity of

facial movement, both volitional and spontaneous, improve.

Quality of life is affected by facial nerve injury. With successful treatment, patients report improvements in their comfort and in their physical function, such as the ability to blink their eyes, to eat, to drink, and to speak. They note less self-consciousness about their physical appearance. Coulson, O'Dwyer, Adams, and Croxon (2004) reported that reduced range of facial movement and high degrees of synkinesis were found to be associated with patient's self perception of poor expression of specific emotions. Improvements in facial muscle movement and synkinesis could be expected to have a beneficial effect on the communication of facial expression. Facial nerve retraining provides these benefits.

Conclusion

Management of the facial nerve patient is based on a detailed assessment. During the initial stages of paresis or paralysis, patient education is critical. Patients must be cautioned against performing gross, nonspecific, and maximal effort exercises, because they have a harmful effect on the recovering facial musculature (Diels, 1995).

As reinnervation occurs, emphasis is placed on symmetrical, controlled movements performed before a mirror. The development of any synkinesis is incorporated into the retraining process. Patients are instructed in balanced, selective exercises, inhibiting or minimizing the synkinesis. The practice of exercises that ignores the presence of synkinesis often leads to a heightening of the abnormal movement patterns (Coulson & Croxon, 1994; Diels, 1995).

Successful rehabilitation of facial nerve dysfunction is tailored to the stage of nerve recovery. It is essential that the development of synkinesis be identified and managed appropriately. Facial neuromuscular retraining has been found to be effective in diminishing the effects of synkinesis and improving voluntary movement (Diels, 1995; Ross et al., 1991).

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Continuing Education Questions

1. What percentage of Bell's palsy cases recovers completely within 3 months?

a. 25%

b. 50%

c. 70%

d. 100%

2. Which of the following facial resting muscle tone findings is consistent with the presence of synkinesis?

a. Absent nasolabial fold

b. Corner of mouth pulled upward

c. Eye widened (increased palpebral fissure)

d. Drooped eyebrow

3. Which of the following is an assessment tool that incorporates the three components of facial resting symmetry, symmetry of voluntary movement and synkinesis?

a. House-Brackmann Facial Nerve Grading System

b. Facial Disability Index

c. Sunnybrook Facial Grading System

d. Estimates of Voluntary Movement

4. Which of the following statements about the Bell's reflex is false?

a. The Bell's reflex involves the eyeball rolling medially.

b. The Bell's reflex is a normal protective reflex.

c. The Bell's reflex occurs when the orbicularis oculi musculature is weak.

d. The Bell's reflex involves the eyeball rolling upward.

5. Which of the following is a relaxation technique for the facial musculature?

a. Ice

b. Face tapping

c. Electric Nerve Stimulation

d. Repeated smile-pucker exercises

New Investigator Grants

Two grants, one sponsored by Division 13 and one sponsored by the Yul Brynner Foundation, are available to qualified applicants at the annual meeting of the Dysphagia Research Society. Each grant will be awarded at the meeting and will be in the sum of $500.00 for innovative research. Check the list of qualifications for each grant below to see if you qualify!

The Division 13 grant is given to a speech-language pathologist for topics related to swallowing function and disorders. The applicant must meet the following criteria:

1. The applicant must be presenter ***and*** first author on the abstract submission (oral or poster format) presented at the 2006 DRS meeting.
2. This must be the first DRS meeting at which the presenter/first author has presented his/her work. That is, the presenter/first author cannot have presented at a prior DRS meeting as presenter/first author. The applicant may have presented for a mentor or have been a co-author on a previous DRS presentation.
3. The candidate must be an ASHA member.
4. The candidate cannot hold a research grant as PI, or be the previous recipient of a research grant, other than student research grant support.
5. The candidate must supply a CV with his/her abstract to be considered for this award.

The Yul Brynner grant is open to all disciplines and is specifically targeted for swallowing research in patients with head and neck cancer. The applicant must meet the following criteria:

1. The applicant must be presenter ***and*** first author on the abstract submission (oral or poster format) presented at the 2006 DRS meeting.
2. This must be the first DRS meeting at which the presenter/first author has presented his/her work. That is, the presenter/first author cannot have presented at a prior DRS meeting as presenter/first author. The applicant may have presented for a mentor or have been a co-author on a previous DRS presentation.
3. The candidate cannot hold a research grant as PI, or be the previous recipient of a research grant, other than student research grant support.
4. The candidate must supply a CV with his/her abstract to be considered for this award.

The next DRS meeting will be March 23-25, 2006, at the Hilton Scottsdale Resort and Villas, Scottsdale, AZ (contact:Bonnie Martin-Harris, PhD, Chair, Division 13 Research Committee, Associate Professor, Otolaryngology Head and Neck Surgery, Medical University of South Carolina, 135 Rutledge Ave, Charleston, SC 29425; Phone: 843-792-7162; E-mail: harrisbm@musc.edu).