

# The Effects of Relaxation/Imagery Training on Recurrent Aphthous Stomatitis: A Preliminary Study

VIVIAN H. ANDREWS, MS, AND HOWARD R. HALL, PHD, PSYD

Recurrent aphthous stomatitis (RAS) is one of the most common diseases of the oral mucosa. Although etiology remains unknown, immunological and emotional disturbances have been implicated in the pathogenesis of RAS. No consistently effective therapeutic regimen has been found. The present study investigates the voluntary modulation of RAS employing hypnosis-like relaxation/imagery training procedures. A multiple baseline design was used to evaluate change in frequency of ulcer recurrence. The role of psychological distress, ratings of perceived pain, and hypnotizability in the treatment of RAS were also examined. Results suggest that the relaxation/imagery treatment program was associated with a significant decrease in the frequency of ulcer recurrence for all subjects. Psychological distress was examined for relationship to ulcer recurrence and symptomatic changes with treatment, but no pattern was found. Finally, little support was found for the role of high hypnotic ability in the treatment of RAS.

## INTRODUCTION

Recurrent aphthous stomatitis (RAS) is one of the most common diseases affecting the oral mucosa. It is characterized by a recurrent pattern of extremely painful single or multiple oral lesions. The number of ulcers per episode varies, with anywhere from one to six ulcers at a time (1). These ulcers range in size from approximately 0.5 to 3 cm in diameter and most ulcers are present for 5 to 7 days and heal

completely without formation of scar tissue in 10 to 14 days (2, 3). Aphthous ulcers most commonly occur on the freely movable, nonkeratinized mucosa, including the lips, buccal mucosa, and the tongue (4). Francis (5), in a review of epidemiological studies of RAS, stated that the incidence of RAS varies with the population studied, ranging from 5% to 60%. Francis (5) estimated that a reasonable estimate of prevalence would be 20%.

Despite extensive research, the etiology of RAS remains unclear (3). The bulk of evidence, however, suggests that RAS is immunologically mediated (3), and more specifically, an imbalance or defect in immune cell subpopulations is suspected (6). RAS has been considered to be an immunological abnormality of the autoimmune variety (7-12), a mild, but permanent immunodeficiency in T-cell subpopulations (6), and/or an abnormal reaction to antigens of oral bacteria such as *Streptococcus sanguis* 2A (1, 13) or *Streptococcus mitis* (14). Unfortunately, no sufficient theory of the immunopathogenesis of RAS has been offered to date, and thus the

---

From the Department of Psychology, The Pennsylvania State University, University Park, Pennsylvania (V.H.A.); and Case Western Reserve University School of Medicine, Department of Pediatrics, Division of General Academic Pediatrics and Rainbow Babies and Childrens Hospital, Cleveland, Ohio (H.R.H.)

Address reprint requests to: Howard R. Hall, Ph.D., Psy.D., Rainbow Babies and Childrens Hospital, Division of General Academic Pediatrics, 2101 Adelbert Road, Cleveland, OH 44106.

Received November 27, 1989; revision received May 15, 1990

## RELAXATION/IMAGERY AND RAS

immunological basis of this disorder remains to be delineated.

Emotional factors have also been implicated in the etiology of RAS as early as the 1800s when this condition was referred to as "neurotic ulcers of the mouth" (2). Previous research has documented an association between RAS and a variety of psychological factors including anxiety, repressed hostility, as well as job related and other stressors (15-18). A more recent study, however, using the Holmes and Rahe Social Readjustment Rating Scale (19), found no association between psychologic life stress and RAS recurrence (20). Other factors considered to play a role in the etiology of RAS are gastrointestinal disturbances and hormonal influences (21-23). Scopp (24) argued for multiple factors in the etiology of RAS, including an immune reaction, genetics, and conditioning factors such as local injury, anxiety, and emotional stress, which affect the severity and frequency of attacks. Scopp (24) stated that the most tenable of factors mentioned as initiating aphthous ulcers are physical or emotional stress that lowers the resistance of the host.

Many different treatment modalities have been suggested for RAS, but at present, no consistently effective therapeutic regimen has been found. Traditional treatments have included cauterizing agents such as phenol and silver nitrate, which alleviate pain by destroying small nerve endings in the oral mucosa. Such treatment results in delayed healing time and the healing of tissue itself may be disturbed (2). Furthermore, excessive use of such agents in patients with chronic recurrences of RAS may result in scarring of the oral tissue. Vitamin treatment has been employed with varying success (16, 25), and treatment with antibiotics and

corticosteroids have also shown conflicting results (2, 16, 26-28). However, long-term use of antibiotics and corticosteroids is not recommended, and therefore they are not a treatment option for patients with chronic recurrences of RAS. Furthermore, although topical corticosteroids can reduce symptoms of RAS, the ulcers still recur (3, 27, 28). On an individual basis, management with topical corticosteroids, antibiotics, topical anesthetics, mouth rinses, and other preparations, including placebos, appears to help some RAS patients (3, 4).

A growing body of scientific and clinical literature suggests that psychosocial variables may influence immunological functioning (29). The field of psychoneuroimmunology (30) has noted an association between stress, classical conditioning, and other behavioral variables, with alterations in immunological functioning. Fewer scientific studies have been reported on attempts to alter immune activity employing relaxation/imagery procedures. Two studies demonstrated the suppression of delayed cutaneous hypersensitivity response in adults following training in hypnosis (31, 32). One study with adults (33) found increases in salivary immunoglobulin A following progressive relaxation training both with and without imagery instructions. Another investigation with children (34), observed increases on this immune measure employing self hypnosis with specific instructions for increasing that immune substance in the saliva. One study involving highly hypnotizable adult subjects failed to find a change in delayed cutaneous hypersensitivity responses following an hypnotic induction (35). The present study investigates the effects of relaxation/imagery training on recurrent aphthous stomatitis.

## METHOD

### Subjects

Subjects were two male and five female volunteers ranging from 16 to 66 years of age. One female subject was referred from the dental practice of Barry Stein, DMD, and all other subjects were volunteers solicited through an announcement in the local newspaper and through a news article describing the study in the Pennsylvania State University campus newspaper. Three subjects were Pennsylvania State University students; other subjects were residents of the Centre County region of central Pennsylvania.

Subjects were invited to participate in the study after the establishment of the diagnosis of recurrent aphthous stomatitis by one of two local dentists, Dr. Senior or Dr. Stein. To qualify for participation in the study, subjects met two additional conditions: (1) subjects reported a history of the disease for a minimum of 1 year without remission; (2) subjects reported that for the last year they have not been free of ulcers for longer than 2 weeks. Subject self-report was corroborated by dental/medical records obtained during the course of treatment in the study. Seven subjects met those conditions and reported a history/duration of RAS ranging from 2 to 40+ years. Subjects characteristics are summarized in Table 1. Subjects met individually with the first author who explained the nature of the study and all of the procedures and measures employed. Each subject signed an Informed Consent Form and was provided with a copy.

### Measures

**Daily Diary.** This measure was designed for subject self-report of the disease symptoms and to assess the frequency of relaxation/imagery practice during the treatment phase of the study. Each Daily Diary sheet was dated, and subjects were asked to report the following: (1) number of ulcers present; (2) rating of pain experienced from the ulcers on a scale of 0–8, where 0 represented no pain; 2, slight pain; 4, moderate pain; 6, severe pain; and 8, very severe pain; and (3) time of relaxation/imagery practice sessions.

**Dental Ratings.** This measure was designed to provide an objective method of assessing the response of RAS to treatment, and to provide a reliability check of subject self-report of ulcer number.

TABLE 1. Subject Characteristics

Subject	Sex	Age	Duration of RAS (yrs)
1	F	50	11
2	F	66	40+
3	F	16	2
4	F	53	10
5	M	27	6
6 <sup>a</sup>	M	22	4
7 <sup>a</sup>	F	24	3

<sup>a</sup> Terminated study during treatment phase.

One of two dentists, Dr. Senior or Dr. Stein, examined the subjects and charted the number of ulcers.

**Symptom Checklist-90 Revised (SCL-90R; (36)).** The SCL-90R is a 90-item self-report symptom inventory designed to assess the psychological symptom patterns of psychiatric and medical patients. It is intended as a measure of current psychological symptom states, and not as a measure of personality. Subjects are asked to report how much discomfort each particular symptom or problem on the SCL-90R has caused them during the past 7 days. The Global Severity Index (GSI) score indicates the overall current level or depth of perceived distress, combining information in the number and intensity of symptoms experienced by the subject.

**Stanford Hypnotic Susceptibility Scale, Form C (Stanford C; (37)).** The Stanford C, a standardized 12-item individually administered scale, was used to assess the hypnotic susceptibility of each subject.

### Design

A single case multiple baseline design across subjects was used to examine the effect of relaxation/imagery training on patients with RAS. In the multiple baseline design across subjects, the dependent variables are measured over time to provide baselines against which change can be evaluated (38). Subjects were randomly assigned to varying lengths of baseline to assess the targeted variables in the absence of intervention. The independent variable (relaxation/imagery training) was then applied to subjects sequentially according to length of baseline. An effect due to treatment is indicated when change occurs in the dependent measures after application of the independent variable. Subjects on longer baselines should exhibit no change in the dependent

## RELAXATION/IMAGERY AND RAS

variables until the treatment is applied. The variable length of baseline thus serves to control for the threat to internal validity posed by concurrent environmental conditions or events that may result in a change in the dependent measures.

Relaxation/imagery training represents the independent treatment variable used in this study. Dependent measures were the Daily Diary ratings of ulcer number and pain, assessment of psychological symptomatology with the SCL-90R, and dental ratings. These dependent measures were employed throughout baseline and treatment. Assessment with the Stanford C was used to examine subject differences in hypnotic susceptibility.

### Procedure

Subjects were individually interviewed by the first author and by Dr. Senior or Dr. Stein to obtain clinical case histories and determine if subjects met the criteria for inclusion in the study. Assignment to dentists was random. Either Dr. Senior or Dr. Stein established the diagnosis of RAS in seven subjects who met the criteria of disease history and ulcer frequency described above and previous dental/medical records were requested. Dr. Senior or Dr. Stein instructed subjects in the identification of RAS ulcers and their differentiation from other mouth sores and conditions.

Baseline Phase. Subjects were randomly assigned to one of three baseline conditions of 4, 6, or 8 weeks in length. There were three subjects in the 4-week baseline condition, two in the 6-week baseline condition, and 2 in the 8-week baseline condition. Subjects in all three baseline conditions signed the Informed Consent Form and were instructed by the first author in the following procedures. Subjects were told to complete one Daily Diary sheet each morning during the course of their daily personal hygiene. Time of day was thus consistent across subjects. Four dental appointments were then made for each of the seven subjects. An attempt was made to keep the day of the week for dental appointments consistent. Dental appointments were spaced at least 1 week apart. Subjects met individually with either Dr. Senior or Dr. Stein at the respective dental offices. At the beginning of each visit, subjects completed one SCL-90R in the waiting room. Dr. Senior or Dr. Stein would then examine each subject and provide dental ratings. Thus, for each of the seven subjects, four baseline measures of psychological

symptomatology and four dental ratings were obtained.

Treatment Phase. Subjects continued to complete one Daily Diary sheet each morning, and answered the question requesting report of relaxation/imagery practice. Twelve dental appointments were made for each subject at the dental office of Dr. Senior or Dr. Stein, and 12 individual appointments for relaxation/imagery training sessions were scheduled with the first author. Appointments for relaxation/imagery treatment followed dental appointments on the same day of the week. As in the baseline phase of the study, appointments were spaced at least 1 week apart.

Each relaxation/imagery treatment session was ½ hour in length (39). All treatment sessions were administered individually by the first author. A script of the procedures was used to standardize the presentation of treatment across subjects and sessions. Intervention began with a relaxation induction. Following the relaxation induction, subjects were asked to imagine scenes to help them become more deeply relaxed. Subjects then moved into the final imagery task involving "immune system imagery." The "immune system imagery" involved a scene described by the first author in which subjects would imagine their white blood cells helping to fight against and heal their mouth ulcers. This imagery period lasted for 5 minutes. Finally, subjects were given a postinduction suggestion, which stated that the white blood cells would continue to work even when the subject was not imagining it directly, and were then brought out of the induction. Immune system imagery has been investigated by the second author in a series of ongoing studies of voluntary immunomodulation of white cell function in healthy individuals.

In the initial treatment session, subjects were trained in the use of the procedures at home and were provided with written instructions outlining the procedures used. They were asked to practice the relaxation imagery procedure twice each day, once in the morning and once in the evening. Subjects were reminded to write down the time of each practice session on their Daily Diary sheets. In subsequent treatment sessions, subjects were asked about their twice daily practice, and any difficulties experienced during home sessions. Additional training was then provided as needed. Following completion of the relaxation/imagery treatment sessions, subjects were assessed on hypnotic susceptibility using the Stanford Hypnotic Susceptibility Scale, Form C (37). This instrument was employed after subjects had completed the treatment phase of the

study, in order to reduce the possibility of the development of negative expectations that might result from scoring low on this test.

## RESULTS

Complete data was collected from five subjects who completed both the baseline and treatment phase (12 relaxation/imagery treatment sessions) of the study. Two subjects completed seven and five treatment sessions, respectively. Actual length of baseline was 1 week longer than the originally specified baseline condition for five of the seven subjects due to scheduling conflicts. Similarly, scheduling conflicts extended the length of the treatment interval for all subjects. For the five subjects who completed all 12 relaxation/imagery treatment sessions, the average length of the treatment phase was 19.4 weeks. Daily Diary ratings of pain and number of ulcers were blocked by week, beginning with day 1 of the baseline phase and continuing through the treatment phase. Each week block involved 7 days of ulcer number and pain ratings. All subjects were highly consistent in completing Daily Diary sheets, with no more than two Daily Dairy ratings missing in any single week block. For any single subject, no more than three blocks contained missing observations. For each week block, mean pain ratings and mean number of ulcers were calculated. Pearson product-moment correlation coefficients between mean pain ratings and mean ulcer ratings over weeks of observations ranged from  $r = 0.76$  to  $r = 0.96$ , with mean correlation of  $r = 0.82$ . Correlations were significant at  $p < 0.01$ . This mean correlation indicates a very strong association between number of ulcers and rating of pain, throughout treatment and

baseline, with no dissociation during relaxation/imagery treatment. Consistency of agreement between subject self-report and objective dental assessment of number of ulcers was calculated by the percentage of times the dentist and subject precisely matched in their report. Percent agreement ranged from 75% to 100%, with a mean percent agreement of 89%. This highly conservative measure (based on 9–16 opportunities for agreement) indicates that subject self-report of ulcer number was highly reliable and accurate. Subjective ratings of experience of pain were more variable, depending on factors such as stage of ulcer development, and could not be verified by objective dental assessment. Therefore, report of mean number of ulcers is the main variable of interest.

Weekly ratings of ulcer number provided only one assessment of the severity of RAS during baseline and treatment. Recurrence of ulcers is highly variable in many patients with RAS. Mean weekly ratings of ulcer number may be inflated by a severe outbreak of multiple ulcers and deflated by several days in which the patient is free of ulcers. Such variability may remain throughout the course of treatment, and mask potential treatment effects such as decrease in the frequency of ulcer outbreaks. To account for this problem, percentage of days with ulcers present (whether just one ulcer or several) was calculated. Treatment effects in which high numbers of ulcers remained, but recurred with less frequency, could then be demonstrated. Percentage of days with ulcers was calculated individually for baseline and for treatment by summing the number of days with ulcers present during either the baseline or treatment phase, and dividing by the total number of observations in the baseline or

## RELAXATION/IMAGERY AND RAS

treatment phase. Percentage of improvement was calculated by subtracting the percentage of days with ulcers during the treatment phase from the percentage of days with ulcers during the baseline phase. This measure provided an indication of any change in the percentage of days with ulcers during the baseline compared with the treatment phase.

To examine the association between psychological symptomatology and ulcers, Pearson product-moment correlation coefficients between mean weekly ulcer number and T-scores on the Global Severity Index (GSI) of the SCL-90R were calculated. Pearson correlations were calculated in two ways: (1) GSI and mean ulcer number for the week the SCL-90R was administered (GSI and Ulcer Rating 1) and (2) GSI and mean ulcer number for the week following administration of the SCL-90R (GSI and Ulcer Rating 2). The first correlation examined the possibility that current presence of ulcers was associated with concomitant psychological distress. The second correlation examined the possibility that current psycho-

logical distress was associated with subsequent development of ulcers.

### Summary

Table 2 summarizes the response of ulcers to the relaxation/imagery treatment for all subjects, and also summarizes the results of assessment of hypnotic susceptibility with the Stanford C. Results indicate significant decreases in percentage of days with ulcers present from baseline to treatment phase. The percentage of improvement ranged from 9.8% to 66.7% for all seven subjects. Mean percentage of improvement for the five subjects who completed all 12 relaxation/imagery treatment sessions was 35.5%. For the two subjects who did not complete treatment, mean percent improvement was 33.2%. If one assumes a binomial distribution, with equal probability that the seven subjects could either increase or decrease in the percentage of days with ulcers present, the probability that all seven subjects would exhibit a decrease from baseline is

TABLE 2. Response of Ulcers to Treatment

Baseline condition	Subject	Mean number of ulcers		Percent days with ulcers		Hypnotic susceptibility
		B <sup>a</sup>	T	B	T	
Complete data (Completed 12 treatment sessions)						
8 weeks	1	1.58	0.33	90.4%	23.7%	8
8 weeks	2	1.09	0.74	69.1%	42.9%	5
6 weeks	3	0.91	0.55	58.0%	21.9%	11
4 weeks	4	1.43	1.80	100%	82.0%	6
4 weeks	5	2.50	1.08	82.4%	51.8%	5
Incomplete data (Completed 7 and 5 treatment sessions respectively)						
4 weeks	6	1.27	0.64	61.3%	51.5%	9
6 weeks	7	1.65	0.20	65.0%	20.0%	9

<sup>a</sup> B, Baseline phase; T, Treatment phase.

$p < 0.008$ . The fact that all subjects did show such a decrease from baseline to treatment is highly significant and suggests that the decrease was not random. The results summarized in Table 2 demonstrate that for six out of seven subjects, a decrease was also exhibited in mean number of ulcers from baseline to treatment. This is significant given the fact that some subjects exhibited severe outbreaks with multiple ulcers during the course of treatment and still showed a decrease in mean number of ulcers. Finally, examination of the hypnotic susceptibility data in Table 2 demonstrates that hypnotic susceptibility ranged from low-moderate (score of 5) to high (score of 11). The Pearson product-movement correlation coefficient between percentage of improvement in number of days with ulcers present and hypnotic susceptibility was  $r = 0.41$  for the five subjects who completed all 12 sessions of treatment.

For all seven subjects who entered treatment, the correlation was  $r = 0.22$ . Although there was some positive association between percentage of improve-

TABLE 4. Pearson Correlations between GSI T-Scores and Ulcer Number

Subject	GSI and ulcer rating 1	GSI and ulcer rating 2
Complete data		
1	$r = 0.40$	$r = 0.85^{**}$
2	$r = 0.55^*$	$r = 0.59^*$
3	$r = 0.73^*$	$r = -0.33$
4	$r = -0.57^*$	$r = -0.45$
5	$r = 0.00$	$r = 0.00$
Incomplete data		
6	$r = 0.26$	$r = 0.17$
7	$r = 0.48$	$r = 0.45$

\*  $p < 0.05$ , \*\*  $p < 0.01$ .

ment and hypnotic susceptibility, the association is not a strong one, and neither correlation is significant. The small number of subjects, however, precludes any strong conclusions on this issue.

Table 3 summarizes the GSI T-score data across baseline and treatment. For six out of the seven subjects, decreases are shown in overall level of psychological distress as measured by the GSI. The mean baseline GSI is 59, decreasing to a mean treatment GSI of 51. This represents a decrease from approximately the 84th percentile of the standardization sample, to approximately the 50th percentile.

Table 4 shows the Pearson correlations for each subject between GSI T-scores and mean number of ulcers for the week the GSI was administered (GSI and Ulcer Rating 1) and the mean number of ulcers the week following administration of the GSI (GSI and Ulcer Rating 2). Both sets of correlations show no consistency across subjects in terms of positive or negative direction, or significance. Although a relationship between psychological distress and number of ulcers may be argued for a few subjects, no strong trend across subjects has been found. In fact, for one subject, both correlations equaled 0, indicat-

TABLE 3. GSI T-scores in Baseline and Treatment

Subject	Baseline GSI	Treatment GSI	
	Mean (Range)	Mean	(Range)
Complete data (12 treatment sessions)			
1	71 (68-72)	67	(65-69)
2	46 (43-51)	36	(30-39)
3	64 (63-65)	55	(50-60)
4	66 (63-70)	65	(63-68)
5	46 (44-50)	49	(39-58)
Incomplete data (7 and 5 treatment sessions)			
6	49 (40-56)	33	(30-38)
7	58 (48-67)	51	(49-52)

## RELAXATION/IMAGERY AND RAS

ing no relationship at all. GSI and Ulcer Rating 1 correlations suggest that presence of ulcers is not strongly related to subject self-report of current level of distress; in fact, for one subject, presence of ulcers was associated with significantly lower report of current distress. Correlations between GSI and Ulcer Rating 2 suggest that, for most subjects, subjective experience of level of distress experienced the previous week is not strongly related to subsequent development of ulcers the following week. Once again, however, the small number of subjects would preclude any strong conclusions on this issue.

### DISCUSSION

In this preliminary study, the effects of relaxation/imagery training on patients suffering from recurrent aphthous stomatitis were investigated through a multiple baseline design across subjects. The results suggest that the 12-session treatment program was associated with a significant decrease in the frequency of ulcer recurrence. The intervention appeared to have an influence on pain through the reduction in number of ulcers, and not directly on the experience of pain itself. Furthermore, relaxation/imagery training in this study appeared to influence the patients' self report of overall psychological distress, as measured by the GSI of the SCL-90R (36). Interestingly, overall level of distress was reduced during treatment, but did not show a strong or consistent relationship with ulcer recurrence. The results imply that presence of ulcers did not increase the patients' subjective experience of distress. Furthermore, the patients' psychological state did not appear to have an influence upon subsequent

development of ulcers. These findings are consistent with the recent research of Pedersen (20), who found no association between psychological life stress and RAS recurrence. Finally, the positive results exhibited with subjects who completed only five or seven treatment sessions suggest that it may be possible to achieve significant change in fewer than 12 sessions of treatment.

Bowers and Kelly (40) reviewed numerous studies on the treatment of physical disease with psychological techniques, including hypnosis, relaxation, and procedures using imagery. They criticize many former studies for not assessing the hypnotic susceptibility of the subjects, arguing that positive results may be mediated by high hypnotic ability (40). In this study, clinical improvement on RAS did not appear to be related to high hypnotic ability as measured by the Stanford Hypnotic Susceptibility Scale, Form C (37). Most subjects fell in the moderate range of hypnotic susceptibility. Thus the influence of the psychological intervention did not appear to be due to a unique effect dependent on high hypnotic ability, but to the relaxation, imagery based procedure. This result is in agreement with Olness et al. (34) who found no relationship between changes in immunoglobulins and hypnotizability scores. Another recent study (41) on the treatment of warts using psychological techniques, also found hypnotizability, and specifically, high hypnotic ability, to be unrelated to clinical improvement. Instead, wart regression was related to the subject's own self-reported ratings of the vividness of the suggested imagery. Spanos et al. (41) suggest the possibility that the imaginal process itself may be the critical variable, or perhaps it is the degree to which the subject becomes actively involved in a process be-

lieved to be therapeutic. The findings contained herein are in agreement with these suggestions, as the procedure employed for relaxation training involved both vivid imagery and the active involvement of the subjects. The second author recently reviewed the research in the area of relaxation/imagery (42). As in the present study, strong empirical support for the role of high hypnotic ability with relaxation/imagery training has not been found. It should be pointed out, however, that the few number of subjects in our study with the resulting low statistical power precludes any strong conclusions about the relationship between hypnotizability and clinical improvements in this preliminary project.

The evidence from research in psychoneuroimmunology (e.g., 30), suggests that

psychosocial factors and psychological treatment approaches may influence immunological functioning. The research reviewed on RAS indicated that there are immunological abnormalities in the etiology and pathogenesis of this condition. The results of this study suggest the possibility of psychological influence on RAS. More research is needed to explore if changes in RAS are associated with immunological alterations. In addition, it is unclear from this preliminary study whether the "immune system imagery" in particular played the significant role in treatment outcome as opposed to another imagery or relaxation process that might have been used. We are continuing research in the area of psychological influences of immune activity with relaxation/imagery procedures.

## REFERENCES

1. Graykowski EA, Barile MF, Lee WB, Stanley HR: Recurrent aphthous stomatitis. Clinical, therapeutic, histopathologic, and hypersensitivity aspects. *JAMA* 196:637-644, 1966
2. McCarthy PL, Shklar G: *Diseases of the Oral Mucosa*. Philadelphia, Lea & Febiger, 1980
3. Scully C, Porter SR: Recurrent aphthous stomatitis: Current concepts of etiology, pathogenesis and management. *J Oral Pathol Med* 18:21-27, 1989
4. Correll RW, Wescott WB, Jensen JL: Recurring, painful, oral ulcers. *JADA* 103:497-498, 1981
5. Francis TC: Recurrent aphthous stomatitis and Behcet's disease: A review. *Oral Surg*, 30:475-487, 1970
6. Pedersen A, Klausen B, Hougen HP, Stenvang JP: T-lymphocyte subsets in recurrent aphthous ulceration. *J Oral Pathol Med* 18:59-60, 1989
7. Lehner T: Recurrent aphthous ulceration and autoimmunity. *Lancet* 2:1154-1155, 1964
8. Lehner T: Stimulation of lymphocyte transformation by tissue homogenates in recurrent oral ulceration. *Immunology* 13:159-166, 1967
9. Lehner T: Pathology of recurrent oral ulceration and oral ulceration in Behcet's syndrome: Light, electron, and fluorescence microscopy. *J Pathol* 97:481-494, 1969
10. Lehner T: Immunologic aspects of recurrent oral ulcers. *Oral Surg* 41:80-85, 1972
11. Dolby AE: Recurrent aphthous ulceration. Effect of sera and peripheral blood lymphocytes upon oral epithelial tissue culture cells. *Immunology* 17:709-714, 1969
12. Rogers RS III, Sams WM, Jr, Shorter RG: Lymphocytotoxicity in recurrent aphthous stomatitis: Lymphocytotoxicity for oral epithelial cells in recurrent aphthous stomatitis and Behcet's syndrome. *Arch Dermatol* 109:361-363, 1974
13. Stanley HR, Graykowski EA, Barile MF: The occurrence of microorganisms in microscopic sections of aphthous and nonaphthous lesions and other oral tissues. *Oral Surg* 18:335-341, 1964
14. Hoover CI, Greenspan JS: Immunochemical comparison of cell wall antigens of various viridans streptococci, including strain 2A + HOT from recurrent aphthous ulceration. *Arch Oral Biol* 28:917-922, 1983

## RELAXATION/IMAGERY AND RAS

15. Miller MF, Ship II, Ram C: A retrospective study of the prevalence and incidence of recurrent aphthous ulcers in a professional population. *Oral Surg* 43:532-537, 1977
16. Sircus W, Church R, Kelleher J: Recurrent aphthous ulceration of the mouth. A study of the natural history, etiology and treatment. *Q J Med* 26:235-249, 1957
17. Ship II, Brightman VJ, Laster LL: The patient with recurrent aphthous ulcers and the patient with recurrent herpes labialis: A study of two population samples. *JADA* 75:645, 1967
18. Ship II, Morris AW, Durocher RT, Burket LW: Recurrent aphthous ulcerations and recurrent herpes labialis in a professional school population. *Oral Surg* 14:30-39, 1961
19. Holmes TH, Rahe RH: The social readjustment rating scale. *J Psychosom Res* 11:213-218, 1967
20. Pedersen A: Psychologic stress and recurrent aphthous ulceration. *J Oral Pathol Med* 18:119-122, 1989
21. Antoon JW, Miller RL: Aphthous ulcers—a review of the literature on etiology, pathogenesis, diagnosis and treatment. *JADA* 101:803-808, 1980
22. Rogers RS, III: Recurrent aphthous stomatitis: Clinical characteristics and evidence for an immunopathogenesis. *J Invest Dermatol* 69:499-509, 1977
23. Ferguson MM, Carter J, Boyle P: An epidemiological study of factors associated with recurrent aphthae in women. *J Oral Med* 39:212-218, 1984
24. Scopp JW: *Oral Medicine: A Clinical Approach with Basic Science Correlation*. St. Louis, The CV Mosby Company, 1973
25. Wray D, Ferguson MM, Mason DK, Hutcheon AW, Dagg JH: Recurrent aphthae: Treatment with vitamin B12, folic acid, and iron. *Br Med J* 2:490-493, 1975
26. Stanley HR: Management of patients with persistent recurrent aphthous stomatitis and Sutton's disease. *Oral Surg* 35:174-179, 1973
27. Merchant HW, Gangarosa LP, Glassman AB, Sobel RE: Betamethasone-17-benzoate in the treatment of recurrent aphthous ulcers. *Oral Surg* 45:870-875, 1978
28. Pimlott SJ, Walker DM: A controlled clinical trial of efficacy of topically applied Fluocinonide in the treatment of recurrent aphthous ulceration. *Br. D J* 154:174-177, 1983
29. Jemmott JB, Locke SE: Psychosocial factors, immunologic mediation, and human susceptibility to infectious diseases: How much do we know? *Psychol Bull* 95: 78-108, 1984
30. Ader R (ed): *Psychoneuroimmunology*. New York, Academic Press, 1981
31. Black S, Humphrey JH, Niven JSF: Inhibition of Mantoux reaction by direct suggestion under hypnosis. *Br Med J* 6:1649-1652, 1963
32. Good RA: Foward: Interactions of the body's major networks. In Ader R (ed). *Psychoneuroimmunology*. New York, Academic Press, 1981
33. Jasnoski ML, Kugler J: Relaxation, imagery, and neuroimmunomodulation. *Ann NY Acad Sci* 496:722-730, 1987
34. Olness K, Culbert T, Uden D: Self-regulation of salivary immunoglobulin A by children. *Pediatrics* 83:66-71, 1989
35. Locke SE, Ransil BJ, Covino NA, Toczydowski J, Lohse CM, Dvorak HF, Arndt KA, Frankel FH: Failure of hypnotic suggestion to alter immune response to delayed-type hypersensitivity antigens. *Ann NY Acad Sci* 496:745-749, 1987
36. Derogatis LR: *The SCL-90R Manual I: Scoring, Administration, and Procedures for the SCL-90R*. Baltimore, Johns Hopkins University School of Medicine, Clinical Psychometrics Unit, 1977
37. Weitzenhoffer AM, Hilgard ER: *Stanford Hypnotic Susceptibility Scale: Form C*. Palo Alto, Consulting Psychologists' Press, 1962
38. Hersen M, Barlow DH: *Single Case Experimental Designs: Strategies for Studying Behavior Change*. New York, Pergamon, 1976
39. Hall HR: Imagery, psychoneuroimmunology, and the psychology of healing. In Kunzendorf RC, Sheikh AA, (eds): *Psychophysiology of Mental Imagery: Theory, Research and Application*. Farmingdale, Baywood Publishing Company, Inc., 1990, 203-227
40. Bowers KS, Kelly P: Stress, disease, psychotherapy, and hypnosis. *J Abnorm Psychol* 88:490-505, 1979
41. Spanos NP, Strenstrom J, Johnston JC: Hypnosis, placebo, and suggestion in the treatment of warts. *Psychosom Med* 50:245-260, 1988
42. Hall HR: Research in the area of voluntary immunomodulation: Complexities, consistencies and future research considerations. *Int J Neurosci* 47:81-89, 1989