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REDUCTION OF DENTAL
POSTSURGICAL SYMPTOMS USING
NONTHERMAL PULSED
HIGH-PEAK-POWER
ELECTROMAGNETIC ENERGY

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Reduction of dental postsurgical symptoms using nonthermal pulsed high-peak-power electromagnetic energy

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Although in the past there was no efficient way to accelerate wound healing, recent investigations reveal remarkable acceleration of the healing process through the use of nonthermal pulsed high-peak-power electromagnetic energy. This therapy increases permeability of edematous tissues so that free flow of blood and other body fluids in the inflamed area is restored, facilitating drainage and tissue repair. The energy released from such therapy penetrates deep into the body tissues and speeds up healing without the tissue damage caused by heat radiation.

Edema and ecchymosis following surgical dental procedures often cause pain, pressure, discoloration, and disfigurement. Any simple method of reducing these postoperative symptoms would be welcome to oral surgeons and their patients. The present clinical investigation demonstrates that nonthermal pulsed high-peak-power electromagnetic energy* is a choice therapeutic conditioner for postoperative healing of traumatic injuries and surgical traumatic injuries and surgical trauma. This study also explains the rationale of why nonthermal pulsed high-peak-power electromagnetic energy (hereinafter designated Diapulse therapy) works in oral surgery.

MATERIALS AND METHODS

The machine used in this study was developed especially to deliver short bursts of nonthermal high-peak-power electromagnetic energy through a movable treatment head. Each burst is 65 microseconds long. The period between bursts is 1,665 microseconds and allows for dissipation of heat in the tissues. There are two basic variables on the machine. First, the pulse frequency can be regulated from 80 to 600 cycles per second. The second variable, a "penetration" setting which regulates watt output, can be varied from 293³ instantaneous

*Delivered by the Diapulse machine manufactured by the Diapulse Corporation of America, 4 Nevada Dr., Lake Success, New Hyde Park, N. Y. 11040.

Table 1. Evaluation of thirty patients given Diapulse therapy pre- and post-operatively

Patient	Age	Sex	Operation	72-hour postoperative			Healing rate
				Pain	Inflam- mation	Effec- tiveness	
1	39	F	Immediate denture	N	N	G	Between 3 and 5 days
2	20	M	Apicoectomy UL2	N	N	G	
3	45	M	Multiple extractions	N	N	E	
4	49	M	Immediate dentures	N	M	G	
5	56	F	Periapical abscess; extraction	N	N	G	
6	19	F	Impaction, LL8, LR8	N	N	G	
7	49	F	Alveolectomy	M	N	G	
8	46	F	Immediate denture	N	N	E	
9	51	M	Immediate dentures	N	M	G	
10	23	M	Fractured mandible	M	N	G	
11	36	F	Fractured mandible	M	N	E	
12	20	M	Impaction, UR8	N	N	E	
13	53	M	Fractured mandible	C	M	E	
14	43	F	Immediate denture	M	M	E	
15	6	M	Multiple extraction; alveolar abscess	N	N	E	
16	39	M	Immediate denture	M	M	G	Between 3 and 5 days
17	26	F	Apicoectomy, UR1 U11	N	N	E	
18	28	F	Impaction, LR8, LL8	C	C	F	
19	18	M	Impaction, LR8	N	N	E	
20	26	F	Impactions, LR8, UR8	N	N	E	
21	44	M	Immediate dentures	M	N	G	
22	24	F	Extraction	N	N	E	
23	67	F	Immediate dentures	M	M	G	
24	39	M	Immediate dentures	N	N	E	
25	64	F	Bilateral alveolectomy	N	N	E	
26	19	F	Apicoectomy, UR1	M	N	G	
27	46	M	Periodontal cystectomy	N	N	E	
28	24	M	Fractured mandible	M	N	G	
29	58	M	Fractured maxilla	N	N	E	
30	19	F	Impaction, LR8, UR8	N	N	E	

Key:

C = Considerable. G = Good.
M = Moderate. E = Excellent.
N = None. F = Fair.

Therapy was given for 15 minutes at 600 pulses and a penetration setting of 6 over the area of the surgical site 24 hours preoperatively and again over the same site immediately prior to the surgical procedure for 10 minutes at previous settings. Immediately following the operation the surgical site was Diapulsed for 10 minutes at the previous settings. The patient was then treated 24, 48, and 72 hours postoperatively over the surgical site for 10 minutes at the same settings.

watts to a maximum of 975 instantaneous watts. Although instantaneous power can reach 975 watts, the interval between energy bursts reduces maximum average pulsed power output to 38 watts.

Ninety patients requiring routine oral and dental surgical procedures were divided into three groups. Twenty-four hours preoperatively, thirty patients (fifteen females and fifteen males) were given Diapulse therapy for 15 minutes at 600 pulses per second, with a penetration setting of 6, over the area of the surgical site. Then again, just prior to the surgical procedure, the area was treated for 10 minutes at the previous settings. Immediately after the operation the surgical site was again energized for 10 minutes, with the machine set as before.

Table II. Evaluation of thirty patients given Diapulse therapy postoperatively

Patient	Age	Sex	Operation	72 hours postoperative			Healing rate
				Pain	Inflam- mation	Effective- ness	
1	23	F	Impaction, LR8, UR8	C	M	G	Between 5 and 7 days
2	47	M	Extraction	M	M	E	
3	38	F	Immediate denture	N	N	G	
4	22	F	Extractions	M	M	G	
5	68	M	Surgical extractions (3)	M	M	G	
6	32	F	Impaction, UL8	N	N	E	
7	42	F	Periodontal cystectomy	N	N	E	
8	18	M	Surgical removal of root tip	N	N	E	
9	40	F	Multiple extractions	M	M	G	
10	39	M	Immediate dentures	N	M	G	
11	23	M	Impaction, LL8	N	N	E	
12	31	M	Impaction, LR8	C	M	G	
13	43	F	Fractured mandible	M	M	F	
14	53	M	Bilateral alveolectomy	M	N	E	
15	29	F	Apicoectomy, UL2	M	N	G	
16	18	F	Apicoectomy, UR1, UL1	M	N	G	
17	38	M	Impaction, LL8	C	M	G	
18	47	M	Immediate denture	M	N	E	
19	42	F	Surgical extraction, UL3	M	N	E	
20	5	F	Multiple extractions	N	M	G	
21	19	M	Immediate denture	N	N	E	
22	45	F	Multiple extraction	N	N	E	
23	29	F	Immediate denture	M	N	G	
24	36	M	Fractured mandible, bilateral	C	C	F	
25	33	F	Impaction, UL8	N	N	E	
26	19	F	Fractured maxilla	C	M	F	
27	8	M	Multiple extractions	N	M	G	
28	20	F	Impaction, UR8, UL8	M	M	G	
29	46	M	Multiple extractions (8)	N	N	E	
30	19	M	Impactions, UR8, LR8	M	N	G	

Key:

C = Considerable. G = Good.
M = Moderate. E = Excellent.
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Immediately following the operation therapy was given for 10 minutes over the surgical site at 600 pulses and a penetration setting of 6. The patient was then treated for the same time and at the same settings 24, 48, and 72 hours postoperatively.

Thirty patients (sixteen females and fourteen males) in a second group received only post-operative Diapulse therapy, 10 minutes immediately following each surgical procedure, and no preoperative therapy. The same 600 pulses per second with a penetration setting of 6 over the surgical site was maintained.

A third group of thirty patients (thirteen women and seventeen men) received no pre- or postoperative therapy. They constituted the control group.

All of the patients in the experimental groups receiving Diapulse therapy were instructed to return for 24-, 48-, and 72-hour therapy for 10 minutes daily at the previous settings. At the end of 72 hours inflammation (edema and ecchymosis), pain, and healing were evaluated. The findings were recorded as "none, moderate, or considerable." The effectiveness of the Diapulse therapy was judged as "excellent, good, fair, or poor." This interpretation required individual consideration of the surgical procedure with its usual postoperative inflammation and pain. Obviously, this is a subject of clinical experience and constitutes a

Table III. Evaluation of thirty patients in the control group not treated with Diapulse

Patient	Age	Sex	Operation	72 hours postoperative			Healing rate
				Pain	Inflam- mation	Effec- tiveness	
1	37	M	Bilateral alveolectomy	M	M	—	Between 10 and 12 days
2	19	F	Surgical extraction, LL8	C	C	—	
3	52	M	Extraction	N	M	—	
4	33	F	Apicoectomy, UL1	C	C	—	
5	39	M	Apicoectomy, UR2	M	C	—	
6	44	F	Multiple extraction	M	M	—	
7	36	F	Multiple extraction	M	M	—	
8	56	M	Root resection, UR8	M	C	—	
9	16	F	Apicoectomy, UR2	C	C	—	
10	30	F	Horizontal impaction, UR3, alveolectomy	C	C	—	
11	27	F	Horizontal impaction, LR8	C	C	—	
12	31	M	Horizontal impaction, UL8	C	C	—	
13	63	M	Multiple extraction; alveolectomy	M	C	—	
14	27	F	Multiple extraction	N	N	—	
15	34	M	Pyogenic granuloma; extraction, LR5, 6	M	M	—	
16	17	F	Impaction, LR8	C	C	—	
17	46	M	Multiple extractions (5)	C	M	—	
18	65	M	Multiple extractions (7)	M	C	—	
19	46	M	Multiple extractions (root tip)	M	M	—	
20	19	M	Impactions, LR8, UR8	C	C	—	
21	26	F	Fractured mandible (midline)	C	C	—	
22	35	M	Alveolectomy	M	N	—	
23	29	M	Apicoectomy	M	M	—	
24	34	M	Multiple extractions (6)	M	M	—	
25	18	F	Impaction, UL8, LL8	C	C	—	
26	21	F	Impactions, UR8	M	M	—	
27	59	M	Multiple extractions (8)	M	C	—	
28	24	M	Alveolectomy	M	C	—	
29	37	M	Impaction, LL8	M	C	—	
30	51	F	Multiple extraction	M	M	—	

Key:

C = Considerable. G = Good.
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variation. The ninety separate postoperative evaluations of inflammation, pain, and therapeusis for the presurgical, postsurgical, and control groups are shown in Tables I, II, and III. The summaries of the evaluations are proved in Tables IV and V, and the statistical analysis is recorded in Table VI.

RESULTS

Pre- and postoperative Diapulse therapy produced a significant shift from "considerable" pain to "none" when the experimental groups were compared to the control group. The subjective nature of pain is essentially determined by the psychologic state of the patient. When the doctor inquires about his patient's pain, the patient may either magnify or minimize his complaint. In the present study only a few patients reported any pain.

Inflammation was absent in 6.7 per cent of the control group, 53.3 per cent of the postoperatively treated group, and 76.7 per cent of the pre- and post-operatively treated group. Moreover, inflammation was "considerable" in 56.6

Table IV. Summary of symptoms observed 72 hours postoperatively

<i>Symptoms and severity</i>	<i>No. of patients</i>	<i>Per cent</i>
<i>Table I group: Treated pre- and postoperatively</i>		
Pain		
None	19	63.3
Moderate	9	30.0
Considerable	2	6.7
Total	30	100.0
Inflammation		
None	23	76.7
Moderate	6	20.0
Considerable	1	3.3
Total	30	100.0
<i>Table II group: Treated only postoperatively</i>		
Pain		
None	12	40.0
Moderate	13	43.3
Considerable	5	16.7
Total	30	100.0
Inflammation		
None	16	53.3
Moderate	13	43.3
Considerable	1	3.4
Total	30	100.0
<i>Table III group: Untreated control</i>		
Pain		
None	2	6.7
Moderate	17	56.7
Considerable	11	36.6
Total	30	100.0
Inflammation		
None	2	6.7
Moderate	11	36.7
Considerable	17	56.6
Total	30	100.0

Table V. Summary of clinical effectiveness of Diapulse therapy 72 hours postoperatively

<i>Clinical effectiveness</i>	<i>No. of patients</i>	<i>Per cent</i>
<i>Diapulse Group 1, pre- and postoperatively treated</i>		
Excellent	15	50.0
Good	13	43.3
Fair	2	6.7
Poor	00	00
Totals	30	100.0
<i>Diapulse Group 2, postoperatively treated</i>		
Excellent	12	40.0
Good	15	50.0
Fair	3	10.0
Poor	00	00
Totals	30	100.0

Table VI. Statistical analysis of Diapulse therapy for dental postoperative symptoms

	<i>Pain</i>	<i>Inflammation</i>	<i>Healing</i>
Group 1, pre- and postoperatively treated			
Mean	1.43	1.27	1.30
Variance	0.391	0.270	0.26
Group 2, Postoperatively treated			
Mean	1.76	1.50	1.55
Variance	0.53	0.442	0.42
Group 3, Untreated			
Mean	2.30	2.50	2.40
Variance	0.355	0.396	0.365
Between Group 1 and Group 2	t = 1.94 alpha = 0.03	t = 1.76 alpha = 0.05	t = 1.45 alpha = 0.06
Between Group 2 and Group 3	t = 3.09 alpha = 0.001	t = 6.70 alpha = 0.001	t = 5.5 alpha = 0.001
Between Group 1 and Group 3	t = 5.51 alpha = 0.001	t = 8.24 alpha = 0.001	t = 7.65 alpha = 0.001

Each sample consisted of 30 patients. For computational purposes, the three categories of pain were given a numerical grade of 1 for none, 2 for moderate, and 3 for considerable. In each case, the method of analysis assumes the hypothesis that the patients in the treated group and the control group are of the same population. Statistical tests are then applied to determine whether to accept or reject this hypothesis. A usually accepted standard of rejection of the hypothesis is that the critical region alpha be equal to 5 per cent (alpha = 0.05).

Analysis of data for the above groups is based upon the Student t distribution.

In these cases, the probability of error in rejecting the hypothesis of equality between the control group and the treated groups is less than 0.1 per cent (alpha = 0.001). In these cases, the critical region for pain yielded an alpha of 0.03; for inflammation, an alpha of 0.05; and for healing, an alpha of 0.06, indicating a confidence level of between 90 and 96 per cent.

per cent of the control group, whereas it was only 3.3 per cent of Group 1 and 3.4 per cent of Group 2. There is substantial evidence that patients subjected to a variety of oral surgical procedures have less pain and less inflammation when treated with Diapulse. Besides its efficacy, I observed no side effects or reactions to the therapy.

COMMENT

Surgical wounds heal by virtue of their ability for self-repair. This is determined by the reaction of the entire body to trauma and by the local tissue environment.^{1, 2} The steps in repair include clot retraction and the release of histamine-like substances which produce vasodilation. As a result of this increased vascularity, cells, serum, and blood plasma invade the wound, producing a swelling at the surgical site. It is commonly believed that partially depolymerized and soluble mucopolysaccharides bind the transudative fluid in the inflamed area as a result of partial osmotic pressure. The wound debris is removed by phagocytic cellular activity and enzymatic digestion.

Four to 5 days after injury, the blood clot dissolves through the action of

macrophages and enzymes. Fibroblasts then become the dominant wound cells and are responsible for regeneration and healing. This takes place after the transudate of inflammation of both cellular and vascular origin diminishes. The fibroblasts arise through proliferation of local connective tissue cells, rather than from precursor cells of the vascular system. Inadequate tissue drainage, poor nutritional state, wound debris, and poor circulation impair healing.

Although in the past there was no efficient method of accelerating wound healing, recent clinical investigations reveal remarkable acceleration of the healing process through the use of Diapulse therapy under controlled conditions.³⁻⁵

Old-time management of oral surgical procedures stressed only local treatment, including the use of cold compresses for the first 24 to 36 hours followed by intermittent moist heat for the next 3 to 6 days. Within the past 15 years, certain systemic medications which reduce edema have been tried.⁶

Antihistamines

Most clinicians agree that antihistamines have only a negligible effect on reduction of edema or acceleration of healing.⁷ The main attribute of these agents is that they influence one of the conditions causing surgical edema.

Corticosteroids

Corticosteroids are administered in an effort to reverse the endocrine balance and for their anti-inflammatory effect. Their side effects nullify their use, particularly if the symptoms are severe or therapy is prolonged.

Antibiotics

Antibiotics are used indiscriminately and dangerously. Furthermore, antibiotics have therapeutic limitations and can produce toxic effects far more serious than the initial condition for which they are given.

Enzymes

Recent clinical studies have shown enzyme preparations effective in a limited way. The action of *animal enzyme preparations* is principally one of activating tissue enzymes which lyse fibrinogen and fibrin, allowing diffusion of the inflammatory exudate from the area of trauma.⁸ In some instances, these preparations have produced some adverse side effects and systemic reactions. The *proteolytic enzymes from plants* (papaya and pineapple), which seem to be more effective for the treatment of pre- and postoperative ecchymosis and edemic manifestations in oral surgery patients, also have limited effectiveness because of systemic reactions, particularly if used alone or in certain chemotherapy combinations.⁹

Diapulse

Diapulse therapy is valuable as a pre- and postoperative conditioner for acceleration of healing in patients undergoing all types of dental surgical pro-

cedure. It is effective in the treatment of traumatic injuries and trauma resulting from surgical operations. Diapulse therapy is free from the side effects, systemic reactions, untoward changes in prothrombin time, tissue ulcerations, and antigenic and sensitivity reactions that have been associated with other therapeutic methods and agents.

Diapulse therapy appears to reverse the decreased tissue permeability which occurs in the inflammatory and edematous reaction. This reaction is associated with the deposition of fibrin and protein molecules in the tissue spaces; thus, the free flow of body fluids is blocked, the resolution of inflammation is impeded, and the resorption of edema is prevented. However, Diapulse decreases the size of molecular deposits through depolymerization. In that way, the permeability of the edematous tissues not only increases, but the free flow of blood and other body fluids in the inflamed area is restored. This facilitates drainage and tissue repair. The anti-inflammatory effect of Diapulse far exceeds that of previous antibiotic and other therapeutic methods.

Diapulse therapy literally diffuses the fibrin and denatured protein molecules in edematous tissues by more than 50 per cent over previously known and accepted forms of therapy. The energy released from Diapulse therapy penetrates deep into the body tissues and speeds up healing without the tissue damage caused by heat radiation.

SUMMARY

Postoperative pain and inflammation usually encountered following many oral surgical procedures have been eliminated or attenuated by the use of non-thermal pulsed high-peak-power electromagnetic energy. In this study, ninety patients requiring a variety of routine oral surgical and dental procedures were divided into two experimental groups and a control group. The first group received pre- and postoperative Diapulse therapy. The second group received only postoperative Diapulse therapy. The third group served as the control and received no Diapulse therapy. The standard of comparison for all cases was an evaluation of inflammation and an expression by the patient concerning the amount of pain felt 72 hours after operation.

Results indicate that the patients given Diapulse therapy pre- and postoperative and those who received it only postoperatively exhibited a statistically and observably significant reduction in pain and inflammation as compared to the nontreated control group. In addition, the group given both pre- and postoperative Diapulse therapy exhibited an additionally significant reduction in pain and inflammation when compared to the group which received only postoperative Diapulse therapy.

The Diapulse-treated patients exhibited a substantial decrease in time required for wounds to heal as compared to the nontreated group. The patients in the group receiving both pre- and postoperative Diapulse therapy required between 3 and 5 days, the patients in the group receiving postoperative Diapulse therapy only required between 5 and 7 days, and the control group receiving no Diapulse therapy required between 10 and 12 days for wounds to heal. The statistical analyses were arrived at by taking healing time for the

pre- and postoperatively treated group at the mean period of 4 days, the post-operatively treated group at the maximum of 7 days, and the control group at the mean of 11 days. These results were analyzed statistically, with a high confidence level of between 90 and 96 per cent.

There was no evidence of side effects or reactions in the tested groups, and no contraindications were established.

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