

CENTER FOR DRUG EVALUATION AND RESEARCH

APPROVAL PACKAGE FOR:

**APPLICATION NUMBER
50-783**

Final Printed Labeling

PERIOSTAT®

(doxycycline hyclate tablets) 20mg

DESCRIPTION

Periostat® is available as a 20 mg tablet formulation of doxycycline for oral administration.

The structural formula of doxycycline hyclate is:

with an empirical formula of $(C_{22}H_{24}N_2O_8 \cdot HCl)_2 \cdot C_2H_6O \cdot H_2O$ and a molecular weight of 1025.89. The chemical designation for doxycycline is 4-(dimethylamino)-1,4,4a,5,5a,6,11,12a-octahydro-3,5,10,12,12a-pentahydroxy-6-methyl-1,11-dioxo-2-naphthacencarboxamide monohydrochloride, compound with ethyl alcohol (2:1), monohydrate.

Doxycycline hyclate is a yellow to light-yellow crystalline powder which is soluble in water.

Inert ingredients in the formulation are: hydroxypropylmethylcellulose, lactose, magnesium stearate, microcrystalline cellulose, titanium dioxide, and triacetin. Each tablet contains 23 mg of doxycycline hyclate equivalent to 20 mg of doxycycline.

CLINICAL PHARMACOLOGY

After oral administration, doxycycline hyclate is rapidly and nearly completely absorbed from the gastrointestinal tract. Doxycycline is eliminated with a half-life of approximately 18 hours by renal and fecal excretion of unchanged drug.

Mechanism of Action: Doxycycline has been shown to inhibit collagenase activity in vitro.¹ Additional studies have shown that doxycycline reduces the elevated collagenase activity in the gingival crevicular fluid of patients with adult periodontitis.^{2,3} The clinical significance of these findings is not known.

Microbiology: Doxycycline is a member of the tetracycline class of antibiotics. The dosage of doxycycline achieved with this product during administration is well below the concentration required to inhibit microorganisms commonly associated with adult periodontitis. Clinical studies with this product demonstrated no effect on total anaerobic and facultative bacteria in plaque samples from patients administered this dose regimen for 9 to 18 months. This product **should not** be used for reducing the numbers of or eliminating those microorganisms associated with periodontitis.

Pharmacokinetics

The pharmacokinetics of doxycycline following oral administration of Periostat® were investigated in 4 volunteer studies involving 107 adults. Additionally, doxycycline pharmacokinetics have been characterized in numerous scientific publications.² Pharmacokinetic parameters for Periostat® following single oral doses and at steady-state in healthy subjects are presented as follows:

Pharmacokinetic Parameters for Periostat®					
	n	C _{max} * (ng/mL)	T _{max} ** (hr)	Cl/F* (L/hr)	t _{1/2} * (hr)
Single dose 20 mg (tablet)	20	362 ± 101	1.4 (1.0 - 2.5)	3.85 ± 1.3	18.1 ± 4.85
Steady-State 20 mg BID***	30	790 ± 285	2 (0.98 - 12.0)	3.76 ± 1.06	Not Determined

* Mean ± SD

** Mean and range

*** Steady-State data were obtained from normal volunteers administered a bioequivalent formulation.

Absorption: Doxycycline is well absorbed after oral administration. In a single-dose study, concomitant administration of Periostat® with a 1000 calorie, high-fat, high-protein meal which included dairy products, in healthy volunteers, resulted in a decrease in the rate and extent of absorption and delay in the time to maximum concentrations

Distribution: Doxycycline is greater than 90% bound to plasma proteins. Its apparent volume of distribution is variously reported as between 52.6 and 134 L.^{4,6}

Metabolism: Major metabolites of doxycycline have not been identified. However, enzyme inducers such as barbiturates, carbamazepine, and phenytoin decrease the half-life of doxycycline.

Excretion: Doxycycline is excreted in the urine and feces as unchanged drug. It is variously reported that between 29% and 55.4% of an administered dose can be accounted for in the urine by 72 hours.^{5,6} Half-life averaged 18 hours in subjects receiving a single 20 mg doxycycline dose.

Special Populations

Geriatric: Doxycycline pharmacokinetics have not been evaluated in geriatric patients.

Pediatric: Doxycycline pharmacokinetics have not been evaluated in pediatric patients (See WARNINGS section).

Gender: Doxycycline pharmacokinetics were compared in 9 men and 11 women under fed and fasted conditions. While female subjects had a higher rate (C_{max}) and extent of absorption (AUC), these differences are thought to be due to differences in body weight/lean body mass. Differences in other pharmacokinetic parameters were not significant.

Race: Differences in doxycycline pharmacokinetics among racial groups have not been evaluated.

Renal Insufficiency: Studies have shown no significant difference in serum half-life of doxycycline in patients with normal and severely impaired renal function. Hemodialysis does not alter the half-life of doxycycline.

Hepatic Insufficiency: Doxycycline pharmacokinetics have not been evaluated in patients with hepatic insufficiency.

Drug Interactions: (See PRECAUTIONS section)

Clinical Study

In a randomized, multi-centered, double-blind, 9-month Phase 3 study involving 190 adult patients with periodontal disease [at least two probing sites per quadrant of between 5 and 9 mm pocket depth (PD) and attachment level (ALv)], the effects of oral administration of 20 mg twice a day of doxycycline hyclate (using a bioequivalent capsule formulation) plus scaling and root planing (SRP) were compared to placebo control plus SRP. Both treatment groups were administered a course of scaling and root planing in 2 quadrants at Baseline. Measurements of ALv, PD and bleeding-on-probing (BOP) were obtained at Baseline, 3, 6, and 9 months from each site about each tooth in the two quadrants that received SRP using the UNC-15 manual probe. Each tooth site was categorized into one of three strata based on Baseline PD: 0-3 mm (no disease), 4-6 mm (mild/moderate disease), ≥ 7 mm (severe disease). For each stratum and treatment group, the following were calculated at month 3, 6, and 9: mean change in ALv from baseline, mean change in PD from baseline, mean percentage of tooth sites per patient exhibiting attachment loss of ≥ 2 mm from baseline, and percentage of tooth sites with bleeding on probing. The results are summarized in the following table.

Clinical Results at Nine Months of Doxycycline Hyclate Capsules, 20 mg, as an Adjunct to SRP (Bioequivalent to Doxycycline Hyclate Tablets, 20 mg)			
Parameter	Baseline Pocket Depth		
	0-3 mm	4-6 mm	≥ 7 mm
Number of Patients (Periostat® 20mg BID)	90	90	79
Number of Patients (Placebo)	93	93	78
Mean Gain (SD ^{//}) in ALv [√]			
Periostat® 20 mg BID	0.25 (0.29) mm	1.03 (0.47) mm*	1.55 (1.16) mm*
Placebo	0.20 (0.29) mm	0.86 (0.48) mm	1.17 (1.15) mm
Mean Decrease (SD ^{//}) in PD [√]			
Periostat® 20 mg BID	0.16 (0.19) mm**	0.95 (0.47) mm **	1.68 (1.07) mm**
Placebo	0.05 (0.19) mm	0.69 (0.48) mm	1.20 (1.06) mm
% of Sites (SD ^{//}) with loss of Alv [√] ≥ 2 mm			
Periostat® 20 mg BID	1.9 (4.2)%	1.3 (4.5)%	0.3 (9.4)%*
Placebo	2.2 (4.1)%	2.4 (4.4)%	3.6 (9.4)%
% of Sites (SD ^{//}) with BOP [√]			
Periostat® 20 mg BID	39 (19)%**	64 (18)%*	75 (29)%
Placebo	46 (19)%	70 (18)%	80 (29)%

* p<0.050 vs. the placebo control group. ** p<0.010 vs. the placebo control group.

[√]Alv = Clinical Attachment Level [√]PD = Pocket Depth [√]BOP = Bleeding on Probing ^{//}SD = Standard Deviation

INDICATIONS AND USAGE

Periostat® is indicated for use as an adjunct to scaling and root planing to promote attachment level gain and to reduce pocket depth in patients with adult periodontitis.

CONTRAINDICATIONS

This drug is contraindicated in persons who have shown hypersensitivity to doxycycline or any of the other tetracyclines.

WARNINGS

THE USE OF DRUGS OF THE TETRACYCLINE CLASS DURING TOOTH DEVELOPMENT (LAST HALF OF PREGNANCY, INFANCY AND CHILDHOOD TO THE AGE OF 8 YEARS) MAY CAUSE PERMANENT DISCOLORATION OF THE TEETH (YELLOW-GRAY-BROWN). This adverse reaction is more common during long-term use of the drugs but has been observed following repeated short-term courses. Enamel hypoplasia has also been reported. TETRACYCLINE DRUGS, THEREFORE, SHOULD NOT BE USED IN THIS AGE GROUP AND IN PREGNANT OR NURSING MOTHERS UNLESS THE POTENTIAL BENEFITS MAY BE ACCEPTABLE DESPITE THE POTENTIAL RISKS.

All tetracyclines form a stable calcium complex in any bone forming tissue. A decrease in fibula growth rate has been observed in premature infants given oral tetracyclines in doses of 25 mg/kg every 6 hours. This reaction was shown to be reversible when the drug was discontinued.

Doxycycline can cause fetal harm when administered to a pregnant woman. Results of animal studies indicate that tetracyclines cross the placenta, are found in fetal tissues, and can have toxic effects on the developing fetus (often related to retardation of skeletal development). Evidence of embryotoxicity has also been noted in animals treated early in pregnancy. If any tetracyclines are used during pregnancy, or if the patient becomes pregnant while taking this drug, the patient should be apprised of the potential hazard to the fetus.

The catabolic action of the tetracyclines may cause an increase in BUN. Previous studies have not observed an increase in BUN with the use of doxycycline in patients with impaired renal function.

Photosensitivity manifested by an exaggerated sunburn reaction has been observed in some individuals taking tetracyclines. Patients apt to be exposed to direct sunlight or ultraviolet light should be advised that this reaction can occur with tetracycline drugs, and treatment should be discontinued at the first evidence of skin erythema.

PRECAUTIONS

While no overgrowth by opportunistic microorganisms such as yeast were noted during clinical studies, as with other antimicrobials, Periostat® therapy may result in overgrowth of nonsusceptible microorganisms including fungi.

The use of tetracyclines may increase the incidence of vaginal candidiasis.

Periostat® should be used with caution in patients with a history or predisposition to oral candidiasis. The safety and effectiveness of Periostat® has not been established for the treatment of periodontitis in patients with coexistent oral candidiasis.

If superinfection is suspected, appropriate measures should be taken.

Laboratory Tests: In long term therapy, periodic laboratory evaluations of organ systems, including hematopoietic, renal, and hepatic studies should be performed.

Drug Interactions: Because tetracyclines have been shown to depress plasma prothrombin activity, patients who are on anticoagulant therapy may require downward adjustment of their anticoagulant dosage.

Since bacterial antibiotics, such as the tetracycline class of antibiotics, may interfere with the bactericidal action of members of the β -lactam (e.g. penicillin) class of antibiotics, it is not advisable to administer these antibiotics concomitantly.

Absorption of tetracyclines is impaired by antacids containing aluminum, calcium, or magnesium, and iron-containing preparations, and by bismuth subsalicylate.

Barbiturates, carbamazepine, and phenytoin decrease the half-life of doxycycline.

The concurrent use of tetracycline and methoxyfluorane has been reported to result in fatal renal toxicity.

Concurrent use of tetracyclines may render oral contraceptives less effective.

Drug/Laboratory Test Interactions: False elevations of urinary catecholamine levels may occur due to interference with the fluorescence test.

Carcinogenesis, Mutagenesis, Impairment of Fertility: Doxycycline hyclate has not been evaluated for carcinogenic potential in long-term animal studies. Evidence of oncogenic activity was obtained in studies with related compounds, i.e., oxytetracycline (adrenal and pituitary tumors), and minocycline (thyroid tumors).

Doxycycline hyclate demonstrated no potential to cause genetic toxicity in an *in vitro* point mutation study with mammalian cells (CHO/HGPRT forward mutation assay) or in an *in vivo* micronucleus assay conducted in CD-1 mice. However, data from an *in vitro* assay with CHO cells for potential to cause chromosomal aberrations suggest that doxycycline hyclate is a weak clastogen.

Oral administration of doxycycline hyclate to male and female Sprague-Dawley rats adversely affected fertility and reproductive performance, as evidenced by increased time for mating to occur, reduced sperm motility, velocity, and concentration, abnormal sperm morphology, and increased pre- and post-implantation losses. Doxycycline hyclate induced reproductive toxicity at all dosages that were examined in this study, as even the lowest dosage tested (50 mg/kg/day) induced a statistically significant reduction in sperm velocity. Note that 50 mg/kg/day is approximately 10 times the amount of doxycycline hyclate contained in the recommended daily dose of Periostat[®] for a 60 kg human when compared on the basis of body surface area estimates (mg/m²). Although doxycycline impairs the fertility of rats when administered at sufficient dosage, the effect of Periostat[®] on human fertility is unknown.

Pregnancy: Teratogenic Effects: Pregnancy Category D. (See WARNINGS Section). Results from animal studies indicate that doxycycline crosses the placenta and is found in fetal tissues.

Nonteratogenic effects: (See WARNINGS Section).

Labor and Delivery: The effect of tetracyclines on labor and delivery is unknown.

Nursing Mothers: Tetracyclines are excreted in human milk. Because of the potential for serious adverse reactions in nursing infants from doxycycline, the use of Periostat® in nursing mothers is contraindicated. (See **WARNINGS** Section).

Pediatric Use: The use of Periostat® in infancy and childhood is contraindicated. (See **WARNINGS** section.)

ADVERSE REACTIONS

Adverse Reactions in Clinical Trials of a bioequivalent form of doxycycline hyclate capsules: In clinical trials of adult patients with periodontal disease 213 patients received 20 mg BID over a 9 - 12 month period. The most frequent adverse reactions occurring in studies involving treatment with a bioequivalent form of doxycycline hyclate capsules or placebo are listed below:

Incidence (%) of Adverse Reactions in Clinical Trials of Doxycycline Hyclate Capsules, 20mg (Bioequivalent to Doxycycline Hyclate Tablets, 20mg) vs. Placebo		
Adverse Reaction	Doxycycline Hyclate Capsules 20 mg BID (n=213)	Placebo (n=215)
Headache	55 (26%)	56 (26%)
Common Cold	47 (22%)	46 (21%)
Flu Symptoms	24 (11%)	40 (19%)
Tooth Ache	14 (7%)	28 (13%)
Periodontal Abscess	8 (4%)	21 (10%)
Tooth Disorder	13 (6%)	19 (9%)
Nausea	17 (8%)	12 (6%)
Sinusitis	7 (3%)	18 (8%)
Injury	11 (5%)	18 (8%)
Dyspepsia	13 (6%)	5 (2%)
Sore Throat	11 (5%)	13 (6%)
Joint Pain	12 (6%)	8 (4%)
Diarrhea	12 (6%)	8 (4%)
Sinus Congestion	11 (5%)	11 (5%)
Coughing	9 (4%)	11 (5%)
Sinus Headache	8 (4%)	8 (4%)
Rash	8 (4%)	6 (3%)
Back Pain	7 (3%)	8 (4%)
Back Ache	4 (2%)	9 (4%)
Menstrual Cramp	9 (4%)	5 (2%)
Acid Indigestion	8 (4%)	7 (3%)
Pain	8 (4%)	5 (2%)
Infection	4 (2%)	6 (3%)
Gum Pain	1 (%)	6 (3%)
Bronchitis	7 (3%)	5 (2%)
Muscle Pain	2 (1%)	6 (3%)

Note: Percentages are based on total number of study participants in each treatment group.

Adverse Reactions for Tetracyclines: The following adverse reactions have been observed in patients receiving tetracyclines:

Gastrointestinal: anorexia, nausea, vomiting, diarrhea, glossitis, dysphagia, enterocolitis, and inflammatory lesions (with vaginal candidiasis) in the anogenital region. Hepatotoxicity has been reported rarely. Rare instances of esophagitis and esophageal ulcerations have been reported in patients receiving the capsule forms of the drugs in the tetracycline class. Most of these patients took medications immediately before going to bed. (See **DOSAGE AND ADMINISTRATION** Section).

Skin: maculopapular and erythematous rashes. Exfoliative dermatitis has been reported but is uncommon. Photosensitivity is discussed above. (See **WARNINGS** Section).

Renal toxicity: Rise in BUN has been reported and is apparently dose related. (See **WARNINGS** Section).

Hypersensitivity reactions: urticaria, angioneurotic edema, anaphylaxis, anaphylactoid purpura, serum sickness, pericarditis, and exacerbation of systemic lupus erythematosus.

Blood: Hemolytic anemia, thrombocytopenia, neutropenia, and eosinophilia have been reported.

OVERDOSAGE

In case of overdosage, discontinue medication, treat symptomatically and institute supportive measures. Dialysis does not alter serum half-life and thus would not be of benefit in treating cases of overdose.

DOSAGE AND ADMINISTRATION

THE DOSAGE OF PERIOSTAT[®] DIFFERS FROM THAT OF DOXYCYCLINE USED TO TREAT INFECTIONS. EXCEEDING THE RECOMMENDED DOSAGE MAY RESULT IN AN INCREASED INCIDENCE OF SIDE EFFECTS INCLUDING THE DEVELOPMENT OF RESISTANT MICROORGANISMS.

Periostat[®] 20 mg twice daily as an adjunct following scaling and root planing may be administered for up to 9 months. Periostat[®] should be taken twice daily at 12 hour intervals, usually in the morning and evening. It is recommended that if Periostat[®] is taken close to meal times, allow at least one hour prior to or two hours after meals. Safety beyond 12 months and efficacy beyond 9 months have not been established.

Administration of adequate amounts of fluid along with the tablets is recommended to wash down the drug and reduce the risk of esophageal irritation and ulceration. (See **ADVERSE REACTIONS** Section).

HOW SUPPLIED

Periostat[®] (white tablet imprinted with "PS20") containing doxycycline hyclate equivalent to 20 mg doxycycline. Bottle of 60 (NDC XXXXX-XXX-XX) and Bottle of 1000 (NDC XXXXX-XXX-XX).

Storage: All products are to be stored at controlled room temperatures of 15°C - 30°C (59°F - 86°F) and dispensed in tight, light-resistant containers (USP).

Rx Only

PERIOSTAT® is a trademark of CollaGenex Pharmaceuticals, Inc., Newtown, PA, 18940

Manufactured by:
Pharmaceutical Manufacturing Services, Inc.
Horsham, PA 19044

Marketed by:
CollaGenex Pharmaceuticals, Inc.
Newtown, PA, 18940

Revised 2/01/01

REFERENCES

1. Golub L.M., Sorsa T., Lee H-M, Ciancio S., Sorbi D., Ramamurthy N.S., Gruber B., Salo T., Kontinen Y.T.: Doxycycline Inhibits Neutrophil (PMN)-type Matrix Metalloproteinases in Human Adult Periodontitis Gingiva. *J. Clin. Periodontol* 1995; 22: 100-109.
2. Golub L.M., Ciancio S., Ramamurthy N.S., Leung M., McNamara T.F.: Low-dose Doxycycline Therapy: Effect on Gingival and Crevicular Fluid Collagenase Activity in Humans. *J. Periodont Res* 1990; 25: 321-330.
3. Golub L.M., Lee H.M., Greenwald R.A., Ryan M.E., Salo T., Giannobile W.V.: A Matrix Metalloproteinase Inhibitor Reduces Bone-Type Collagen Degradation Fragments and Specific Collegenases in Gingival Crevicular Fluid During Adult Periodontitis. *Inflammation Research* 1997; 46: 310-319.
4. Saivain S., Houin G.: Clinical Pharmacokinetics of Doxycycline and Minocycline. *Clin. Pharmacokinetics* 1988; 15: 355-366.
5. Schach von Wittenau M., Twomey T.: The Disposition of Doxycycline by Man and Dog. *Chemotherapy* 1971; 16: 217-228.
6. Campistron G., Coulais Y., Caillard C., Mosser J., Pontagnier H., Houin G.: Pharmacokinetics and Bioavailability of Doxycycline in Humans. *Arzneimittel Forschung* 1986; 36: 1705-1707.

← 4 1/2" →

↑ 1 7/8" ↓

<p>INERT INGREDIENTS: Hydroxypropyl Methylcellulose, Lactose, Magnesium Stearate, Microcrystalline Cellulose, Titanium Dioxide, Triacetin. See package insert for dosage information. Store at controlled room temperature 15°–30°C (59°–86°F)</p>	<p>NDC 000000-000-00</p> <p>Periostat (doxycycline hyclate tablets)</p> <p>20 mg 60 Tablets</p> <p></p>	<p>Manufactured for: CollaGenex Pharmaceuticals, Inc. Newtown, PA 18940 Manufactured by: PMRS, Inc. Horsham, PA 19044</p> <p style="text-align: right;">Lot. No. 00000000 Exp. date: 0/0/00</p>
 00000 000-00	 0000-00	
<p>Rx Only.</p>		

60's bottle label

Shown actual size

5 1/2"

NDC 000000-000-00

Periostat
(doxycycline hyclate tablets)

20 mg
1000 Tablets

 **COLLAGENEX**
pharmaceuticals

Rx Only

3 1/2"

INERT INGREDIENTS:
Hydroxypropyl Methylcellulose,
Lactose, Magnesium Stearate,
Microcrystalline Cellulose, Titanium
Dioxide, Triacetin.
See package insert for
dosage information.
Store at controlled room
temperature 15°-30°C (59°-86°F)

Manufactured for:
CollaGenex
Pharmaceuticals, Inc.
Newtown, PA 18940
Manufactured by:
PMRS, Inc.
Horsham, PA 19044

Lot No. 00000000
Exp. date: 0/0/00


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1000's bottle label

Shown actual size

6"

4"

NDC 000000-000-00

Periostat (doxycycline hyclate tablets)

20 mg

12 Bottles X 60's

INERT INGREDIENTS:

Hydroxypropyl Methylcellulose, Lactose, Magnesium Stearate, Microcrystalline Cellulose, Titanium Dioxide, Triacetin. See package insert for dosage information. Store at controlled room temperature 15° -30°C (59° -86°F)



Rx Only.

Manufactured for:
CollaGenex Pharmaceuticals, Inc.
Newtown, PA 18940
Manufactured by:
PMRS, Inc.
Horsham, PA 19044



60's shipper label

Shown actual size

3 3/16"

Periostat
(doxycycline hyclate tablets) 20 mg

Dosage:
One tablet
twice a day

Periostat
(doxycycline hyclate tablets) 20 mg

Each 20 mg tablet contains 20 mg doxycycline hyclate as its active ingredient. Inert ingredients: Hydroxypropyl Methylcellulose, Lactose, Magnesium Stearate, Microcrystalline Cellulose, Titanium Dioxide, Triacetin. See package insert for dosage information.

Store at controlled room temperature 15°-30°C (59°-86°F)

Professional sample-not for sale.

Rx Only.



CollaGenex Pharmaceuticals, Inc., Newtown, PA 18940

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Periostat
(doxycycline hyclate tablets) 20 mg

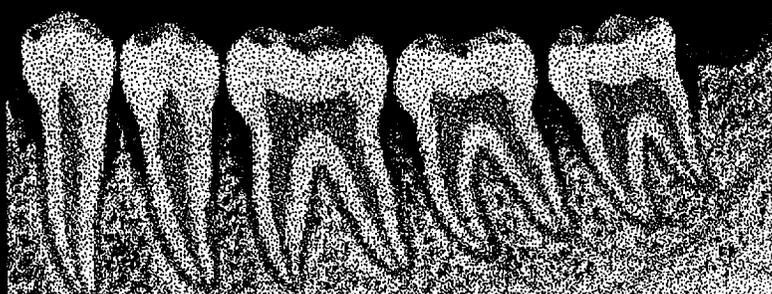
2 3/4"

5/8"

Periostat
(doxycycline hyclate tablets) 20 mg

Dosage:
One tablet
twice a day

Periostat
(doxycycline hyclate tablets) 20 mg



Package contains
eight 20 mg tablets

Dosage:
One tablet twice a day

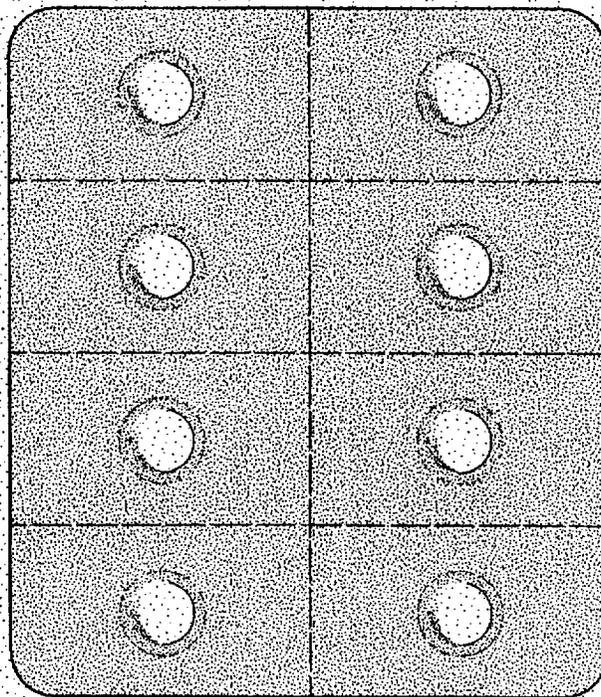
Periostat
(doxycycline hyclate tablets) 20 mg

Lot #000000
Expires 06/00

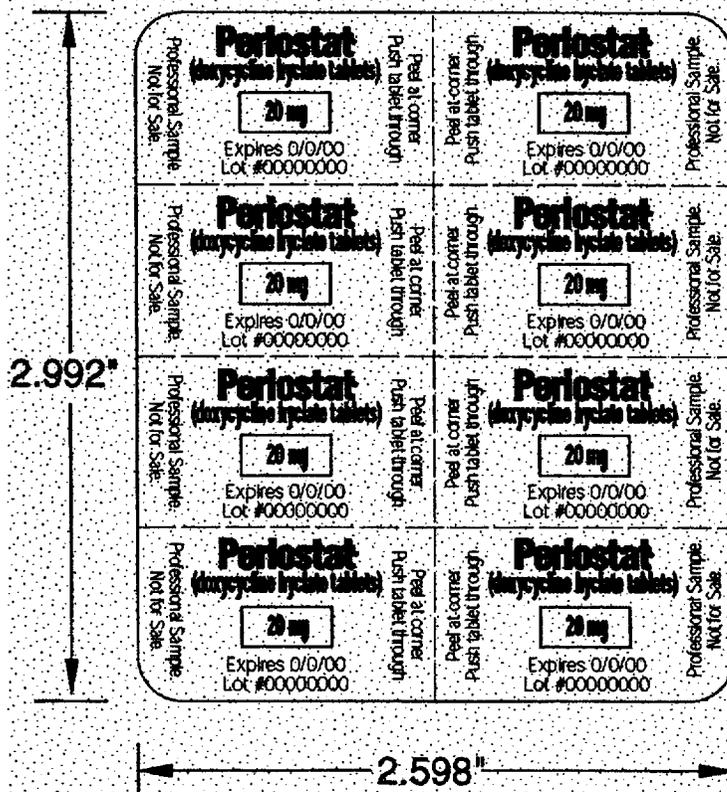
Periostat sample box

Shown actual size

Front



Back



Periostat tablets sample card

Shown actual size

6 5/8"

4 1/2"

Periostat[®] (doxycycline hyclate tablets) 20 mg

COLLAGENEX
PHARMACEUTICALS

Periostat[®] (doxycycline hyclate tablets) 20 mg

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Periostat 20 mg twice daily as an adjunct following scaling and root planing may be administered for up to 9 months. Safety beyond 12 months and efficacy beyond 9 months have not been established.

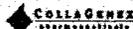
Periostat should be administered at least one hour prior to morning and evening meals.

See enclosed package insert for full prescribing information.

Keep this and all medications out of the reach of children.

Storage: Store at controlled room temperature 15°-30°C (59°-86°F).

This display unit contains 10 patient samples containing 8 tablets each



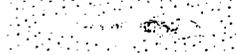
Collagenex Pharmaceuticals, Inc., Newtown, PA 19040
©2001 Collagenex Pharmaceuticals, Inc. (10-02) (date)

4 1/2"

Periostat[®] (doxycycline hyclate tablets) 20 mg

Each package contains eight 20 mg tablets
Dosage: One tablet twice a day

Perfostat® sample display
(Holds 10 sample boxes)



 COLLAGENEX
PHARMACEUTICALS



Perfostat
sample display
holds 10

