

## Analysis of Patient Factors Impacting Duration of Periodontal Maintenance Appointments: An Exploratory Study

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### Introduction

Periodontal maintenance (PM) is imperative for long-term success of periodontal treatment.<sup>1-10</sup> While treatment of periodontal disease may encompass a variety of procedures (surgical and non-surgical) designed to restore health to the periodontium, nonsurgical therapy including removal of subgingival plaque and calculus by scaling and root planing remains the standard of care.<sup>11-24</sup> Current accepted practice for non-surgical PM is a 45 to 60 minute appointment with follow-up appointments at 3 month intervals.<sup>8,16,22,25,26</sup> While effectiveness of the 3 month PM appointment interval has been well documented, very little evidence exists to support the customary 45 to 60 minute time-frame parameter, with the exception of a report by Schallhorn et al.<sup>25</sup> Their landmark citation set the standard for PM therapy, reporting a typical PM appointment taking 52.61 minutes, including average time spent on the various PM components (Table I). According to the American Academy of Periodontology (AAP), the current standard for PM treatment-considerations recommends time be individualized and dictated by such factors as number of teeth or implants, patient cooperation, oral hygiene efficacy, compliance, systemic health, previous PM frequency, instrumentation access, history of disease or complications, and distribution and depth of the sulci.<sup>26</sup> Despite this, no data exists in contemporary literature providing guidance on the relative contribution of these factors to total-time needed for effective PM.

### Abstract

**Purpose:** The periodontal maintenance (PM) appointment requires varying amounts of time and is absolutely essential for long-term successful periodontal therapy. This study assessed time requirements for PM and relative contribution of patient-level factors such as oral health status, complex medical history, maintenance compliance and demographics.

**Methods:** One hundred patients receiving PM in a graduate periodontal program at a dental school participated in this cross sectional, observational study and components of their PM were timed in minutes/seconds. Descriptive data were obtained for average total-time required for PM and relative time for each treatment component. Hierarchical multiple linear regression determined what patient-level factors demonstrated the greatest impact on total-time to complete PM.

**Results:** The average PM appointment interval, with radiographs, was 1 hour, 16 minutes, 23 seconds (SD 19:25 minutes). When cublicle preparation and disinfection was included, the total-time was 1 hour, 24 minutes, 31 seconds ( $\pm 19:32$  minutes). Multiple regression showed that BOP, dentist examinations, number of carious lesions and/or restorative defects, number of teeth/implants, taking radiographs, female gender and deposit aggregate (supragingival and subgingival calculus and stain) were significant predictors of total PM duration and explained 57% variance ( $p < 0.05$ ,  $R^2 = 0.569$ ).

**Conclusion:** Based on the average comprehensive PM appointment time of 1:16 minutes, the typical appointment of 60 minutes is insufficient to achieve the goals of a comprehensive PM in this academic clinic setting. These findings suggest the need to utilize more customized models for scheduling PM in order to achieve time allocations that are individualized to address specific patients' needs.

**Keywords:** periodontal disease/therapy, patient care planning, appointment and schedules, dental prophylaxis, oral hygiene, continuity of patient care

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Although Schallhorn et al have provided guidance on PM therapy,<sup>25</sup> in the 3 decades since its publication there have been significant changes in patient care, e.g. in-depth medical history, contemporary standards of care on compe-

**Table I: Components of typical PM appointment and time requirements (taken from Schallhorn and Snider<sup>25</sup>) and Comparison of PM components between Schallhorn and Snider vs. AAP Position Paper<sup>26</sup>**

	Schallhorn and Snider, 1981 25	2003 AAP Position Paper 26
8.50 min	<b>Patient greeting</b> <b>Health and dental history</b> Brief review of patient's chart and radiographs; update patient's history through conversation. If change in patient's health that will affect treatment, dentist is consulted.	<b>Review and update of medical/dental history</b> <b>Radiographic examination</b> Current, diagnostically readable radiographs based on the needs of the patient, for evaluation and interpretation of the status of the oral structures, teeth, periodontium, and dental implants. Clinician judgment, prevalence and/or degree of disease progression, will determine need, frequency, and number of radiographs. Note radiographic abnormalities
1.12 min	<b>Dental screening</b> Includes: visual extraoral exam of face, lips, neck, and a brief, intraoral exam of oral mucosa, tongue, floor of the mouth, pharynx, tonsillar area, and palate; examination of oral tissues for evidence of cancer, or other aberration. If any pathologic condition is present, it is recorded in the chart and dentist consulted.	<b>Clinical examination (to be compared with previous baseline measurements)</b> Extraoral exam, recording of results Intraoral exam, recording of results: Oral soft tissue evaluation Oral cancer evaluation
3.25 min 0.22 min	<b>Periodontal assessment</b> Color, architecture Exudation Pocket/sulcus Recession Fremitus	<b>Periodontal examination to include dental implants and peri-implant tissues and recording of results:</b> Probing depths Bleeding on probing Evaluation of furcations Exudate Other signs of disease progression Microbial testing if indicated Gingival recession Attachment levels if indicated Tooth mobility, fremitus Occlusal factors, Examination Evaluation of implant stability Occlusal adjustment, if indicated Other signs and symptoms of disease activity (e.g., pain, etc.)

hensive periodontal examinations, utilization of electronic records and universal precautions for infection control, to name a few. Obviously, the advent of universal infection control procedures has increased the time required for providing care as many of the standards became effective after 1981.<sup>27</sup> Furthermore, advancements in medical/dental technology and improved life styles have allowed Americans to live longer while retaining much of their natural dentition.<sup>28,29</sup> However, while innovations improved health and life expectancy, many elderly are disabled, suffering from chronic medical and oral conditions requiring time-consuming medical/dental management.<sup>30,31</sup> Consequently, the progressive evolution of patient care, federal safety regulations and the complexity and interaction of variables

that can impact treatment, suggests the customary time-frame parameter outdated and insufficient when considering the goals of a contemporary PM visit.<sup>26,27,32</sup>

The purpose of this study was to systematically evaluate the relative time requirements for each PM component and overall total-time for a PM appointment. Additionally, the study was designed to determine the degree patient-level characteristics, such as oral health status, complex medical history, maintenance compliance and demographics contribute to variation in time required for the contemporary PM visit, as these data may provide guidance for determining time estimates useful in treatment planning.

Table I: Components of typical PM appointment and time requirements (taken from Schallhorn and Snider<sup>25</sup>) and Comparison of PM components between Schallhorn and Snider vs. AAP Position Paper<sup>26</sup> (continued)

3.04 min 5.00 min	<b>Plaque index (with aid of assistant)</b> <b>*Plaque index (without assistant)</b> Patient performs hygiene care prior to appt., teeth are disclosed, use of O'Leary index, compare previous visits.	<b>Assessment of personal oral hygiene</b> General levels of plaque and calculus
4.20 min	<b>Oral hygiene review</b> Therapist must discern underlying problem of poor hygiene as one of motivation, dexterity, or understanding.	<b>Behavioral modification</b> Oral hygiene reinstruction Adherence to suggested PM intervals Counseling on control of risk factors (e.g., smoking, nutrition, stress)
6.83 min 10.05 min	<b>Scaling/root planning</b> Ultrasonic with aid of assistant <b>Hand instrumentation and instrument sharpening</b>	Removal of subgingival and supragingival plaque and calculus. Selective scaling or root planning, if indicated Occlusal adjustment, if indicated
10.90 min	<b>Polishing/flossing</b> Polish and floss teeth before S/RP to minimize embedding polishing agent to interfere with healing.	<b>Polishing teeth</b>
1.00 min	<b>Assess caries, defective restorations</b> After scaling/root planning and polishing. Caries, fractured restoration, or problems with prostheses, assessment of the dentition.	<b>Dental examination and recording of results</b> Coronal and root caries assessment Restorative and prosthetic factors, defective restorations, open contacts or malpositioned teeth Exam of prosthesis/abutment components
1.50 min	<b>Chemical therapy</b> For compromised maintenance or recurrent disease, irrigation with saline solution or Chloramine T, anti-formin TX, and antimicrobial agents.	Use of systemic antibiotics, local antimicrobial agents, or irrigation procedures, as necessary
1.00 min	<b>Fluoride rinse</b> For caries control and desensitization of roots.	Root desensitization, if indicated
1.00 min	<b>Patient dismissal, re-appointment</b>	<b>Assessment of disease status</b> or changes by reviewing the clinical and radiographic examination findings, compared to baseline <b>Communication</b> Informing the patient of current status and need for additional treatment if indicated Consultation with other health care practitioners who may be providing additional therapy or participating in the PM program, or whose services may be indicated. <b>Planning</b> For most patients with a history of periodontitis, visits at 3-month intervals may be required initially. Based on evaluation of clinical findings and assessment of disease status, PM frequency may remain the same, be modified, or the patient may return to mechanical, chemical, surgical, and/or non-surgical treatment. Surgical therapy (or discontinuation of periodontal maintenance and treatment of recurrent disease), if indicated.
Total	<b>52.61 min</b>	

## Methods and Materials

### Sample

Upon approval from the Institutional Review Board (IRB), the primary investigator was responsible for recruiting, explaining procedures, collection of all data and performing all PM procedures on all subjects. The investigator had 40 years of combined practice experience in periodontal private, government and academic settings. Volunteer subjects signed informed consent and Health Insurance Portability and Accountability Act (HIPAA) forms. All subjects were assigned a study number to ensure anonymity and utilization of all data collection.

A cross sectional, observational study design was utilized. A convenience sample of 100 consecutive patients presenting for PM treatment were recruited starting in August 2009 and completed in November 2009. Inclusion criteria required subjects understand spoken English, have  $\geq 6$  teeth, be between age 30 to 89 years, exhibit moderate to severe periodontitis conforming to case types III or IV (American Dental Association (ADA) Periodontal Classification)<sup>33</sup> and meet the American Society of Anesthesiologists (ASA) physical status of ASA I, II, or III.<sup>34</sup> Exclusion criteria included patients presenting with acute periodontal abscess, and/or ASA IV or VI health status.<sup>34</sup> It should be noted the ADA classification of periodontal disease status was used in lieu of the 1999 classification of periodontal diseases/conditions due to available electronic programmed software.<sup>33,35</sup>

### Procedures

Patient data, consisting of the various PM components, were entered electronically using electronic clinical management software (Paradox<sup>®</sup> Runtime, Corel Corporation, Ottawa, Ontario) and included oral and medical examinations, medications, restorative charting, treatment notes, treatment planning and digital radiographs using electronic radiographic imaging (MiPACS<sup>®</sup> Dental; Medicor Imaging, Charlotte, North Carolina). Periodontal assessment data included: probing depths (PD), gingival recession, bleeding on probing (BOP), plaque index (6 sites per tooth), tooth mobility, furcation involvement and any other existing muco-gingival problems or conditions.<sup>36</sup> Annual or periodic dental examinations and periodontal consultations were provided as needed by a small cohort of supervising periodontists who provided care consistent with that in practice, depending on individual need.

### Format Utilized

Component time and overall appointment duration was recorded using a digital software stop-

watch/count-down timer (XNote Stopwatch<sup>®</sup> dnSoft Research Group, Cheboksary, Russia) measuring time intervals in seconds, minutes and hours. The software was loaded on the same computer as the electronic dental record for ease of data collection. The primary feature of the stopwatch included the ability to "snap" and record times in minutes/seconds with a single mouse click for each treatment component to include the following: greeting patient, radiographic evaluation/assessments and/or taking necessary radiographs, medical/dental history, dental/oral examinations, periodontal examinations, oral hygiene assessments and communication, instrumentation/treatment phase, dentist examinations, and treatment planning and patient dismissal. These features allowed for time efficiency, while minimizing errors collecting data, and prevented the process of data collection from adding substantially to overall appointment duration. Timing results were collected in a standardized manner and duplicated with each participant utilizing a pre-determined component sequence (Table II). After participants were released, the recorded data were copied and saved, and the stopwatch was re-set for next subject.

### Pilot Study

Pilot testing was used to determine a standardized total-time allocation for pre- and post-infection control procedures. The authors were primarily interested in capturing the variance in PM time as described by AAP Parameter of Care;<sup>32</sup> however, infection control procedures are important to consider in overall appointment planning. Since infection control occurs in the inter-appointment interval where many other actions take place, we elected to isolate the pre- and post-infection control time and obtained an average estimate uncontaminated by other non-PM care factors. The standardized infection control time was derived by timing a total of 10 sessions, (5 operative set-ups and 5 break-downs) for the PM treatment according to the Center for Disease Control (CDC) and Occupational Safety and Health Administration (OSHA) guideline standards.<sup>27</sup> It should be noted the subsequent regression modeling did not include the time for infection control.

### Statistical Design and Analysis

An observational, cross-sectional study design was utilized. Subjects were observed at a single time point and received PM therapies as indicated. Data were analyzed descriptively to obtain relative time needed for each component and overall average time required for PM procedures. For these analyses, the PM treatment time excluded time allocated for the inter-appointment cubicle preparation and disinfection procedures. Hierarchical multiple linear regres-

**Table II** Periodontal maintenance component sequence used in current study

Greeting
Greet and seat patient, sign-in to electronic patient chart.
Medical History
Health assessments: medications, blood pressure screening, take blood glucose or INR as indicated. Consultation with other health care practitioners who may be providing additional therapy, or whose services may be indicated prior to treating patient.
Radiology
Radiographic assessments, and/or taking necessary digital radiographs.
Dental/Oral Examination
Extra-oral, Intraoral examinations: oral soft tissue evaluation, oral cancer screening. Dental Examinations: caries assessment, defective restorations, overhangs, open contacts, etc.
Periodontal Examination
Full mouth probing/pocket depths, bleeding upon probing, furcation involvement, gingival recession, exudate, tooth mobility, plaque index, implant evaluation, muco-gingival conditions.
Oral Hygiene Assessments/Communication
Assessing disease status, personal oral hygiene, informing patient of current status and need for additional treatment if indicated, to include but not limited to: Behavioral Modification, Motivational Interviewing, Oral hygiene review/instruction, adherence to PM intervals, counseling on control of risk factors (stress, smoking, nutrition, health status, etc.).
Instrumentation/Treatment Phase
Removal of subgingival/supragingival plaque and calculus, to include selective scaling and root-planing if indicated (using ultrasonic and hand-instrumentation, instrument sharpening, polishing and flossing teeth). Administration of topical and/or local anesthetics, nitrous oxide, chemical therapy; local antimicrobial agents, irrigation agents, localized drug delivery, exposed root desensitization, and/or fluoride, as indicated.
Dentist Examination/Periodontal Consultation, Treatment Planning
Dentist/Periodontist examinations/consultation as indicated. PM intervals based on evaluation of clinical and radiographic findings and assessment of disease status; PM frequency may remain same, be modified, or patient may return for mechanical, chemical, surgical, and/or non-surgical treatment.
Patient Dismissal
Gathering patient's belongings, dispensing homecare items, scheduling patient for next appointment. Finish electronic record notes and sign out of electronic chart.
Variables
Any unforeseen, occurring during PM appointment time noted.

sion analysis with a backward elimination approach was used to determine which patient-level factors and various components of the appointment have the greatest impact on treatment time to complete PM procedures. Backward elimination was used to produce the simplest explanatory model for explaining variance in treatment time as a function of key patient-based and appointment-based predictor variables, while controlling for collinearity amongst predictors.

## Results

One hundred subjects were enrolled out of 102 screened, with 100 consenting and 99 subjects available for analysis, as 1 subject was exited from the study due to determined need to re-activate al-

ternative care. The number of subjects enrolled in the study each day ranged from 1 to 4. Given the clinician's typical schedule treating 6 PM patients per day, fatigue was not likely given the ratio of the number of patients seen vs. the number enrolled per day. Demographic characteristics (Table III) reveal an average age of 64.4 years, and a 3% greater distribution of women than men. Periodontal case type status revealed 42% of subjects classified as case type III and 57% case type IV.<sup>33</sup> More than half (53%) of subjects were ASA III.<sup>34</sup> While the majority of subjects (75%) reported taking 1 to 5 medications, almost half (47%) had previously smoked, with 12% current smokers.

Results from clinical summary data (Table IV) shows the average number of teeth including im-

Table III: Sample characteristics

	All Participants (n=99)	Periodontal Class III33 (n=42)	Periodontal Class IV33 (n=57)
<b>Age</b>			
Mean (SD)	64.4 (11.1)	63.6 (11.2)	65.0 (11.1)
<b>Gender</b>			
Males	48 (48%)	18 (38%)	30 (62%)
Females	51 (51%)	24 (47%)	27 (53%)
<b>ASA Classification<sup>34*</sup></b>			
I	23 (23%)	10 (43%)	13 (57%)
II	23 (23%)	8 (35%)	15 (65%)
III	53 (53%)	24 (45%)	29 (55%)
<b>Number of Medications<sup>†</sup></b>			
0	1 (1%)	0 (0%)	1 (100%)
1 to 5	75 (75%)	32 (43%)	43 (57%)
6 to 10	12 (12%)	6 (50%)	6 (50%)
11 to 20	10 (10%)	4 (40%)	6 (60%)
>20	1 (1%)	0 (0%)	1 (100%)
<b>Tobacco Use</b>			
Never	40 (40%)	20 (50%)	20 (50%)
Previous	47 (47%)	19 (40%)	28 (60%)
Current	12 (12%)	3 (25%)	9 (75%)
<b>Last Recall (months)</b>			
Mean (SD)	4.6 (2.4)	4.7 (2.1)	4.5 (2.6)
Median (SIQ)	3.2 (0.8)	4.1 (1.1)	3.7 (0.7)
Proportion On Time +1 month	75.5%	71.4%	78.6%
Proportion Overdue 1 to 4 months	19.4%	26.2%	14.3%
Proportion Overdue >5 months	5.1%	2.4%	7.1%

\* ASA Classifications:<sup>34</sup> I healthy, II mild-moderate systemic disease, or III controlled severe systemic disease

† Number of medications taken daily

plants among subjects was 23.5 ( $\pm 4.4$ ), and an equal distribution in periodontal case types III and IV.<sup>33</sup> Mean BOP was equal among the case types, averaging 16.3% ( $\pm 19.0\%$ ) for case type III and 16.5% ( $\pm 15.0\%$ ) for case type IV.<sup>33</sup> Subjects were relatively compliant with their PM recall frequency with a median PM recall of 3.2 (SI 0.8) months. An average proportion (63%) were overdue for their PM appointment, with the range of months for those overdue being 2 to 4 months. Almost half (42%) exhibited poor oral hygiene as noted in the mean percent of plaque among all subjects 41.0 ( $\pm 28.1$ ). Aggregate deposits were categorized as slight, moderate or heavy in range, with the majority of subjects exhibiting slight deposits. In the present investigation the amount of deposit was used to account for variations in treatment time based on patient condition. The extent of inflammation among subjects presenting for PM varied and was not measured beyond the dependent parameters listed.

The average time required for PM components

(Table V) reveals total-time for completion of the PM visit was 1 hour, 16 minutes, 23 seconds ( $\pm 19:25$  minutes). Additionally, the average inter-appointment time needed for cubicle preparation and disinfection was 8.08 ( $\pm 0.07$ ) minutes, making the average overall appointment interval in this study 1 hour, 24 minutes, 31 seconds ( $\pm 19:32$  minutes). As expected, the greatest amount of time was spent on the treatment phase, averaging 29:34 ( $\pm 7:21$ ) minutes, followed by the periodontal examination at 14:23 ( $\pm 4:26$ ) minutes. Obtained radiology times were highly variable due to a variety of circumstances, e.g., differences in type/and or number of digital radiographs taken, institutional barriers, and differential time to evaluate existing radiographic films from past appointments.

Preliminary bivariate analyses were conducted to determine the relationship between patient-level factors and overall PM time and provide guidance in selecting predictors for the multiple regression analysis. Patient-level factors that had a significant

Table IV: Clinical characteristics of subjects

	All Participants (n=99)	Periodontal Class III <sup>33</sup> (n=42)	Periodontal Class IV <sup>33</sup> (n=57)
Mean (SD)			
Number Teeth/Implants	23.5 (4.4)	24.0 (4.0)	23.0 (4.6)
% Pockets 4 to 6 mm	25.3 (16.6)	22.4 (15.4)	27.5 (17.3)
% Pockets > 7 mm	1.1 (2.4)	0.1 (0.3)	1.8 (2.9)
% BOP *	16.4 (17.0)	16.3 (19.0)	16.5 (15.0)
Furcations	6.6 (5.5)	4.3 (4.0)	8.2 (5.8)
Caries/Defects	4.1 (3.6)	3.6 (3.3)	4.5 (3.8)
% Plaque	41.0 (28.1)	40.0 (30.0)	41.0 (27.1)
Clinical Findings	n (%)	n (%)	n (%)
Oral Hygiene			
Good	22 (22%)	10 (45%)	12 (55%)
Fair	35 (35%)	16 (46%)	19 (54%)
Poor	42 (42%)	16 (38%)	26 (62%)
Supra Calculus			
None	2 (2%)	1 (50%)	1 (50%)
Slight	62 (62%)	29 (47%)	33 (53%)
Moderate	29 (29%)	11 (38%)	18 (62%)
Heavy	6 (6%)	1 (17%)	5 (83%)
Sub Calculus			
None	18 (18%)	10 (56%)	8 (44%)
Slight	60 (60%)	27 (45%)	33 (55%)
Moderate	19 (19%)	5 (26%)	14 (74%)
Heavy	2 (2%)	0 (0%)	2 (100%)
Stain			
None	15 (15%)	10 (67%)	5 (33%)
Slight	50 (50%)	25 (50%)	25 (50%)
Moderate	14 (14%)	3 (21%)	11 (79%)
Heavy	20 (20%)	4 (20%)	16 (80%)
Medical/ Pathology Consult	12 (12%)	4 (33%)	8 (67 %)
Dentist Examinations	30 (30%)	10 (33%)	20 (67 %)
Fluoride Treatment	85 (85%)	35 (41%)	50 (59%)
Other Interventions †	16 (16%)	3 (19%)	13 (81%)

\*BOP=% Bleeding on Probing

†INR, Blood Glucose, Nitrous Oxide, Local Drug Deliver, or Local Anesthesia

relationship ( $p<0.05$ ) with mean appointment time were female gender, supragingival calculus deposits, radiographs, number of teeth, medical consultations, number of medications, percent BOP, percent pockets 4 to 6 mm, and dentist examinations. Data were subsequently entered into a multiple regression model using a backward elimination approach, with the criterion for variable removal set at  $p>0.10$ . The resulting model explained 57% of variance in overall treatment time ( $p<0.05$ ;  $r^2=0.569$ ) as a linear function of predictors (Table VI). The resulting model included the following predictors: radiographs, dentist examinations, number of teeth/

implants, aggregate deposits (supra-gingival and sub-gingival calculus, stain), percent BOP, number of carious lesions/restorative defects, and gender (female). This demonstrated that these predictors contributed unique variance with part  $r^2=0.09$ , 0.02, 0.05, 0.05, 0.03, 0.02 and 0.02, respectively.

## Discussion

The goal of this study was two-fold - to systematically evaluate the relative time requirements for each PM component and collectively considered the overall total duration time for a comprehensive

PM appointment, and to identify patient-level and appointment-level factors that have the greatest impact on treatment time variability. The estimated average comprehensive PM treatment interval for the PM visit was 1 hour, 16 minutes, 23 seconds ( $\pm 19:25$  minutes). Modeled separately was the average time needed to complete universal infection control procedures between PM appointments; 8.08 ( $\pm 0.07$ ) minutes. Not surprising, the variability in total treatment time was fairly large and most likely a result of tailoring care to each individual's needs, as recommended by AAP<sup>26,32</sup> and the CDC/OSHA.<sup>27</sup> Considering the mean (SD) total PM time, it is evident that a standardized appointment time for PM of 45 to 60 minutes is likely insufficient to achieve the goals of comprehensive PM for the majority of periodontal patients. Only 19 of the 99 subjects in this trial were treated in less than 60 minutes, despite the experience of the clinician-investigator, with over 40 years of clinical practice and exclusively treated periodontal patients in previous private practice, as well as this academic clinical facility. Moreover, none of these 19 patients required radiographs during the PM, which would have added considerably to treatment time (on average 22 minutes), as was demonstrated as explaining approximately 9% of unique variance in the regression model.

Results from the predictive model clearly suggest that PM scheduling schemas must be approached to address the patient-level characteristics, periodontal needs of the patient, expected standards of care in regards for periodic diagnostic assessment, as well as fit the characteristics of patients in the practice. Annual comprehensive examinations and/or the need for radiographs would likely require more extensive time allotted for the appointment than 2 or 3 month PM visits. A variety of models could be employed, including modifying the amount of time with the hygienist and/or scheduling a separate appointment for diagnostic evaluation with the dentist, depending on the patient's individual needs and the practice characteristics.

Although there is a small body of literature reporting time estimates for providing dental treatment,<sup>37-39</sup> the majority focused on initial periodontal therapy and did not specifically consider the PM appointment. Schallhorn et al is the singular study that reported on time needed for PM.<sup>25</sup> Furthermore, past studies relied on either dentists self-report of time needed or used crude assessments (e.g., using a wall clock) to evaluate time for

Table V: Periodontal maintenance component times\*

(n=99)	Mean	SD
Greeting	2:57	1:21
Medical History	3:50	3:48
Radiology	6:06	9:33
Dental Examinations	3:23	2:06
Periodontal Examinations	14:23	4:26
Oral Hygiene/Assessments	5:25	4:44
Treatment Phase	29:34	7:21
Dentist Exams/Treatment Planning	6:21	2:42
Dismissal	3:22	2:38
Total PM Time	1:16:23	19:25
OSHA †	8:08	0:07
Appointment Interval	1:24:31	19:32

\* Timing in hours: minutes: seconds

† OSHA Compliance Pilot Study

care, and used multiple clinicians and/or multiple sites for collecting data.<sup>37-39</sup> Additionally, common standards for calibration among providers were not accounted for nor were practitioner experiences or differing treatment philosophies that may have influenced procedures and subsequent time variation. To confound findings further, some studies reported utilizing dental assistants, others did not, and yet other studies were inconclusive. In the current study, an assistant was not utilized to make results more generalizable to dental hygiene practice. Moreover, a recent review article by Tan identified the difficulty in estimating PM treatment time, reporting there will always be variations in terms of disease severity, number of teeth, training of the personnel involved and "degree of difficulty."<sup>40</sup> Consequently, the current study is the only investigation to standardize procedures and clinician, and employ a system of accurately capturing time for each PM component while not interfering with patient care.

Results from this study indicate the greatest amount of unique variance in total-time, 0.09, was demonstrated when radiographs were required. On average and, not surprisingly, there was a 22 minute difference in total treatment time for the PM when any radiographs were obtained. In addition, the examination by the dentist added approximately 9.22 (SD=4.2) minutes to the overall time which is likely typical for other comprehensive examinations. The physical setting of this study (a graduate periodontics clinic within a school of dentistry) allowed for impromptu dental examinations

Table VI: Regression model parameters for predicting PM treatment time (excluding cubicle preparation and disinfection) by patient-level and appointment parameters. ( $r^2=0.569$ )

Variable	Coefficient	Std. Error	Part R2	p
Constant	19.69	9.77	–	0.047
Radiographs *	22.01	4.98	0.092	0.0001
Dentist Examination	9.17	4.20	0.023	0.032
Teeth/Implants †	0.99	0.31	0.048	0.002
Deposits ‡	2.11	0.66	0.048	0.002
Percent BOP	0.23	0.09	0.030	0.014
Caries/Defects §	1.24	0.61	0.019	0.046
Gender (female)	5.53	2.78	0.019	0.049

\* Any radiographs taken

† Number of Teeth/Implants

‡ Aggregate of Deposits (Supragingival and Subgingival Calculus, Stain)

§ Number of carious lesions, (frank and incipient) and defective restorations

similar to that which would be expected in a busy private practice setting. The PM appointment time will vary considerably depending on whether a periodic exam and/or radiographs are needed or not. Variable exam times may also differ depending on whether the exam is performed by a general dentist versus a periodontist. A systematic review explored whether supportive care provided by a specialist practice produced different clinical outcomes than those provided in a generalist practice.<sup>41</sup> Collectively, results from the 14 studies that met criteria for inclusion demonstrated less attachment loss for patient treated by periodontists and concluded that these are likely a result of greater overall time being devoted to PM in the specialty practice.<sup>41</sup> It is noteworthy, however, that a recent study compared cost effectiveness of supportive periodontal care provided by periodontal practices in Spain, UK, Australia, U.S., Ireland, Germany Japan and Sri Lanka.<sup>42</sup> These authors' conclusions suggest that PM in private practice, at least in the U.S., may be cost effective if clinicians placed a greater value on preventing attachment loss in periodontal patients. In theory, preventing attachment loss will increase tooth retention and thus prevent the monetary costs associated with tooth replacement. One might also argue that the quality of life costs associated with unnecessary tooth loss should be part of the discussion. Irrespective, the financial impact of increasing the average appointment time does have implications for dental practices that must be considered relative to provider's philosophy on tooth retention over a person's lifespan. In particular, one must weigh the relative tradeoffs between allotting sufficient time to individualize care to achieve better patient outcomes and less dental disability over time, with the increased pa-

tient and practice liability from compromising care due to inadequate time.

Also, not surprisingly, the number of teeth/implants and the amount of deposits were significant predictors, both explaining 0.05 variance, as the more teeth an individual retains, and the heavier the deposits, the more time required to perform a comprehensive PM. This is particularly relevant because the aging U.S. population is living longer and retaining more teeth now than ever before. While age was not a significant predictor in this study, our sample was representative of older dentate adults. In the U.S., the older population has shifted from a predominately edentulous one in years past, to a contemporary one with an average of 20 teeth/person.<sup>28,30</sup> Epidemiological studies suggest that periodontal diseases are cumulative over time resulting in an increase from 6% among persons 25 to 34 years to 41% among those 65 years and older.<sup>43</sup> Tooth retention, coupled with other oral health related issues, suggests that the need to individually allot time for PM will continue to be an issue in rendering appropriate treatment.

Additionally, BOP was also a significant predictor contributing uniquely to time for PM at 3%. It is noteworthy that for each 1% increase in BOP there is a comparable increase of 0.23 minutes in treatment time. Clinically translated, this suggests that the predicted additional time needed for a patient with 80% BOP compared to a patient with 10% BOP would be approximately 16 additional minutes (0.23\*70). The same is true for aggregate deposits in this study. A composite variable was created by summing the 0 to 3 ordinal rankings for plaque, supra- and subgingival calculus, and stain scores to

produce an aggregate score that ranged from 0 to 12. Extrapolating the regression coefficient for deposits to the clinical setting suggests that for each increase in deposit score, there is a concomitant increase of approximately 2 minutes in time needed for PM. While results from the study cannot definitely be used to develop a firm algorithm for appointment planning, it is clear that for patients with poor periodontal control (higher BOP and deposits scores), a longer appointment time should be systematically developed and implemented. Comprehensive PM is critical for creating a biologically compatible environment that patients can maintain during the PM interval. Whereas the absence of BOP is a reliable predictor for the maintenance of periodontal health,<sup>44</sup> the presence of BOP and/or deposits may suggest ongoing compromised periodontal status, or generalized or site-specific recurrent disease which could justifiably require additional treatment considerations. Obviously, removal of calculus or heavy stain from coffee/tea or tobacco is yet another time-consuming procedure compared to a well-maintained mouth.

The results also demonstrate the presence of carious lesions and defective restorations was a significant predictor in treatment time, explaining an additional 2% in unique treatment time variance. As with the deposit aggregate score, a dental defect score was computed by summing the number of incipient and frank carious lesions, and number of restorative defects. In our sample, 20% of the subjects had no defects and 35% had more than 6 defects. Clinically, for each 1 unit increase in defect score, there would be a concomitant increase in total-time of a little over 1 minute. The importance of allotting sufficient time for diagnosing and thorough debridement of dental defects cannot be overstated. Defective overhanging dental restorations (ODR) have been strongly implicated as an etiologic factor in the progression of periodontal disease and are alarmingly prevalent.<sup>45</sup> In one study, 59% of restorations had overhanging margins with 32% BOP.<sup>46</sup> In addition to promoting plaque accumulation, ODRs promote the aggregation of gram-negative anaerobic pathogenic microbes.<sup>47</sup> A fundamental aspect of PM is thorough assessment of local factors which results in the need for more time if there are multiple defects compared to intact and healthy dentition. Lastly, gender was a statistically significant predictor (0.02) of treatment time, with women having treatment times on average 6 minutes longer. The contribution of this variable to the model deserves special consideration. Our participants were largely an older (mean age 64.4 years) and less healthy population seeking care for Class III and IV<sup>33</sup> periodontal disease, with 76% having an ASA II classification,<sup>34</sup> and 23% reported taking

>6 medications. However, women were more likely to be taking >6 medications (29.4%) compared to males (20.8%) despite the relatively even distribution of gender in the study. Moreover, women were more likely to have an ASA II or III classification than men.<sup>34</sup> Given these characteristics, it's likely that the gender may also have been confounded by health status or other potential factors. While oral health has been attributed to less education, less positive attitudes towards oral health, and environmental factors, data on these potential confounders were not acquired on subjects in this study; therefore, it is not possible to explore other reasons why women required more time for the PM.<sup>48</sup>

Although older adults are living longer and healthier lives, many present with complex medical histories, managing multiple chronic diseases, both physical and psychological that, in turn, require multiple medications.<sup>49</sup> Indeed, such medical histories frequently require time-consuming medical/dental management often resulting in consultations with other health care providers. A 2010 report shows the number of prescription drugs consumed increases with age, e.g., 40% of patients aged >65 years take 5.7 medications.<sup>50,51</sup> Medication use and age related chronic diseases, and their possible interactions with periodontal disease highlight the importance of a thorough medical history and consultation as necessary. Clearly this adds time to the PM appointment but is imperative for successful PM and overall health, safety and welfare of the patient.

As with most clinical studies, there are limitations to the current investigation. Subjects were treated according to AAP (2003) guidelines for care, within an academic health center clinic by a single clinician with 40 years of experience. While this reduced inter-clinician and multiple-site variance, it also limits generalizability to well-experienced clinicians who use the recommended standard of care for PM, as outlined by AAP. Future studies are needed that employ multiple clinicians with varying levels of experience from different settings (e.g., general and specialty practices) to evaluate the impact of these potential sources of variability. Well-designed, mixed-effects designs (patients clustered within clinicians, clustered within site), while expensive to conduct, would provide valuable insight and more generalizable findings with regard to treatment times. Furthermore, it is impossible to assess whether subjects in this study were substantially different than those seen in private practice. The difficulty in accurately capturing periodontal prevalence rates in the U.S. is highly dependent upon how "disease" is operationalized.<sup>52</sup> In our population, women had greater prevalence

of 4 to 6 mm pockets compared to men (29% vs. 22%), but men were more likely to have pockets >7 mm (2% vs. 0.7%). Severity of disease and oral hygiene status were not related to increasing age; however, participants were largely older with only 21% younger than 55 years old. Participants in this study varied according to periodontal severity, health status, tobacco use and adherence to PM intervals, thus representing a fairly wide range of periodontal patients. Dentist examinations were performed by board certified periodontists, who likely performed more thorough exams than would be typical by general dental practitioners. While many, but not all, of the AAP recommendations coincide with procedures used for PM in this study,<sup>26,32</sup> the relative mix of specific procedures that make up service categories shared by general and specialty practices is an important issue to explore for future research. Finally, it seems prudent to conduct studies on the effect of using an electronic patient chart (compared to paper record) on treatment time, as this could be an additional predictor of time duration variance on the PM appointment.

## Conclusion

Results indicate the average duration time required 1 hour, 16 minutes, 23 seconds to achieve the goals of PM. Thus, the typical 45 to 60 minute appointment was insufficient for the average PM patient in this study. Clearly, each of the patient-level and practice factors have an impact on the amount of time needed to accomplish PM. Clinical significance and practical guidance from the results of this study suggests the need for clinicians to de-

velop meaningful individual rubrics for estimating individual PM appointment times. While the data from this study may provide guidance in this respect, it is important to note that a one size fits all approach should be avoided. While our average total-time estimate of 1 hour, 25 minute PM appointment may be appropriate in this academic practice setting, it is not generalizable to all populations. Our results do suggest, however, the need for dental hygienists and dentists to engage in meaningful conversation regarding best practices and develop models that are individualized to fit their patient's needs and practice characteristics. These results may provide some guidance on which elements of the PM appointment are most variable. A systematic approach reflecting the individual's unique characteristics and goals for that PM appointment could justifiably contribute to improved time and stress practice management, while, improving cost effectiveness and reducing liability.

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## References

1. Axelsson P, Lindhe J. The significance of maintenance care in the treatment of periodontal disease. *J Clin Periodontol.* 1981; 8(4): 281-294.
2. Becker W, Becker BE, Berg LE. Periodontal treatment without maintenance. A retrospective study in 44 patients. *J Periodontol.* 1984; 55(9): 505-509.
3. Hirschfeld L, Wasserman B. A long-term survey of tooth loss in 600 treated periodontal patients. *J Periodontol.* 1978; 49(5): 225-237.
4. Checchi L, Montevercchi M, Gatto MR, Trombelli L. Retrospective study of tooth loss in 92 treated periodontal patients. *J Clin Periodontol.* 2002; 29(7): 651-656.
5. Lindhe J, Nyman S. The effect of plaque control and surgical pocket elimination on the establishment and maintenance of periodontal health. A longitudinal study of periodontal therapy in cases of advanced disease. *J Clin Periodontol.* 1975; 2(2): 67-79.
6. Axelsson P, Nystrom B, Lindhe J. The long-term effect of a plaque control program on tooth mortality, caries and periodontal disease in adults. Results after 30 years of maintenance. *J Clin Periodontol.* 2004; 31(9): 749-757.
7. Nyman S, Lindhe J, Rosling B. Effect of professional tooth cleaning on healing after periodontal surgery. *J Clin Periodontol.* 1975; 2(2): 80-86.

8. Ramfjord SP. Maintenance care and supportive periodontal therapy. *Quintessence Int.* 1993; 24(7): 465-471.
9. Rosling B, Nyman S, Lindhe J, Jern B. The healing potential of the periodontal tissues following different techniques of periodontal surgery in plaque-free dentitions. A 2-year clinical study. *J Clin Periodontol.* 1976; 3(4): 233-250.
10. Research, Science and Therapy Committee of the American Academy of Periodontology. Treatment of plaque-induced gingivitis, chronic periodontitis, and other clinical conditions. *J Periodontol.* 2001; 72(12): 1790-1800.
11. Cobb CM. Non-surgical pocket therapy: mechanical. *Ann Periodontol.* 1996; 1(1): 443-490.
12. Greenstein G. Nonsurgical periodontal therapy in 2000: A literature review. *J Am Dent Assoc.* 2000; 131(11); 1580-1592.
13. Drisko CH. Nonsurgical periodontal therapy. *Periodontol 2000.* 2001; 25; 77-88.
14. Badersten A, Nilveus R, Egelberg J. Effect of nonsurgical periodontal therapy. II. Severely advanced periodontitis. *J Clin Periodontol.* 1984; 11(1): 63-76.
15. Becker W, Becker BE, Caffesse RG, et al. A longitudinal study comparing scaling, osseous surgery and modified Widman procedures: Results after 5 years. *J Periodontol.* 2001; 72(12): 1675-1684.
16. Hill RW, Ramfjord SP, Morrison EC, et al. Four types of periodontal treatment compared over two years. *J Periodontol.* 1981; 52(11): 655-662.
17. Lindhe J, Westfelt E, Nyman S, Socransky SS, Haffajee AD. Long-term effect of surgical/non-surgical treatment of periodontal disease. *J Clin Periodontol.* 1984; 11(7): 448-458.
18. Kaldahl WB, Kalkwarf KL, Patil D, Molvar MP, Dyer JK. Long-term evaluation of periodontal therapy: I. Response to 4 therapeutic modalities. *J Periodontol.* 1996; 67(2): 93-102.
19. Garrett JS. Effects of nonsurgical periodontal therapy on periodontitis in humans. A review. *J Clin Periodontol.* 1983; 10(5): 515-523.
20. Morrison EC, Ramfjord SP, Hill RW. Short-term effects of initial, nonsurgical periodontal treatment (hygienic phase). *J Clin Periodontol.* 1980; 7(3): 199-211.
21. Magnusson I, Lindhe J, Yoneyama T, Liljenberg B. Recolonization of subgingival microbiota following scaling in deep pockets. *J Clin Periodontol.* 1984; 11(3): 193-207.
22. Ramfjord SP, Caffesse RG, Morrison EC, et al. 4 modalities of periodontal treatment compared over 5 years. *J Clin Periodontol.* 1987; 14(8): 445-452.
23. Pihlstrom BL, McHugh RB, Oliphant TH, Ortiz-Campos C. Comparison of surgical and nonsurgical treatment of periodontal disease. A review of current studies and additional results after 6-1/2 years. *J Clin Periodontol.* 1983; 10(5): 524-544.
24. Jeffcoat MK, McGuire M, Newman MG. Evidence-based periodontal treatment. Highlights from the 1996 World Workshop in Periodontics. *J Am Dent Assoc.* 1997; 128(6); 713-724.
25. Schallhorn RG, Snider LE. Periodontal maintenance therapy. *J Am Dent Assoc.* 1981; 103(2): 227-231.
26. Cohen RE, Research, Science and Therapy Committee, American Academy of Periodontology. Position Paper: Periodontal Maintenance. *J Periodontol.* 2003; 74(9): 1395-1401.
27. OSHA (Occupational Safety and Health Administration/CDC (Center for Disease Control and Prevention). Guidelines for the dental office. OSHA [Internet]. [cited 2010 January 23] Available from: <http://www.osha.gov/SLTC/dentistry/index.html>
28. Vargas CM, Kramarow EA, Yellowitz JA. The Oral Health of Older Americans. *Aging Trends.* 2001; (3): 1-8.
29. Loesche WJ, Grossman NS. Periodontal disease as a specific, albeit chronic, infection: Diagnosis and treatment. *Clin Microbiol Rev.* 2001; 14(4): 727-752.
30. Niessen LC. Aging successfully: Oral health for a lifetime. *J Esthet Dent.* 1998; 10(5): 226-228.

31. Ries LAG, Eisner MP, Kosary CL, Hankey BF, Miller BA, Clegg L, et al. SEER Cancer Statistics Review, 1975-2002, National Cancer Institute [Internet]. Available from: [http://seer.cancer.gov/csr/1975\\_2002/](http://seer.cancer.gov/csr/1975_2002/)
32. American Academy of Periodontology (AAP). Parameter on periodontal maintenance. *J Periodontol.* 2000; 71(5): 849-850.
33. American Dental Association (ADA). Periodontal type and case classification. ADA [Internet]. [cited 2008 February 19]. Available from: <http://www.ada.org/3063.aspx>
34. Physical Status Classification System. American Society of Anesthesiologists [Internet]. [cited 2008 February 19]. Available from: <http://www.ashq.org/clinical/physicalstatus.htm>
35. Armitage GC. Development of a classification system for periodontal diseases and conditions. *Ann Periodontol.* 1999; 4(1): 1-6.
36. O'Leary TJ, Drake RB, Naylor JE. The plaque control record. *J Periodontol.* 1972; 43(1): 38.
37. Klein H, Dollar ML, Bagdonas JE. Dentist time required to perform dental operations. *J Am Dent Assoc.* 1947; 35(3): 153-160.
38. Miller NA, Benamghar L, Martin G, Penaud J. Evaluation of time needed to treat periodontal conditions classified according to the C.P.I.T.N. index. *Acta Odontostomatol (Paris).* 1990; 44(171): 513-522.
39. Ekanayaka AN, Sheiham A. Estimating the time and personnel required to treat periodontal disease. *J Clin Periodontol.* 1978; 5(2): 85-94.
40. Tan AES. Periodontal maintenance. *Aus Dent J.* 2009; 4(Suppl 1):S110-117.
41. Gaunt F, Devine M, Pennington M, et al. The cost-effectiveness of supportive periodontal care for patients with chronic periodontitis. *J Clin Periodontol.* 2008; 35(8): 67-82.
42. Pennington M, Heasman P, Gaunt F, et al. The cost-effectiveness of supportive periodontal care: a global perspective. *J Clin Periodontol.* 2011; 38(6): 553-561.
43. Brown LJ, Brunelle JA, Kingman A. Periodontal status in the United States, 1988-91: Prevalence, extent, and demographic variation. *J Dent Res.* 1996; 75: 672-683.
44. Lang NP, Adler R, Joss A, Nyman S. Absence of bleeding on probing: An indicator of periodontal stability. *J Clin Periodontol.* 1990; 17(10): 714-721.
45. Brunsvoid MA, Lane JJ. The prevalence of overhanging dental restorations and their relationship to periodontal disease. *J Clin Periodontol.* 1990; 17(2): 67-72.
46. Pack AR, Coxhead LJ, McDonald BW. The prevalence of overhanging margins in posterior amalgam restorations and periodontal consequences. *J Clin Periodontol.* 1990; 17(3): 145-152.
47. Lang NP, Kiel RA, Anderhalden K. Clinical and microbiological effects of subgingival Restorations with overhanging or clinically perfect margins. *J Clin Periodontol.* 1983; 10(6): 563-578.
48. Sabbah W, Tsakos G, Chandola T, Sheiham A, Watt RG. Social Gradients in Oral and General Health. *J Dent Res.* 2007; 86(10): 992-996.
49. CDC (Center for Disease Control and Prevention). Chronic disease prevention and health promotion. CDC [Internet]. [cited 2010 January 23]. Available from: <http://www.cdc.gov/chronicdisease/stats/index.htm>
50. Gu Q, Dillon CF, Burt VL. Prescription drug use continues to increase: U.S. prescription drug data for 2007-2008. *NCHS data brief.* 2010; (42): 1-8.
51. Practice Policy. American Society of Health-System Pharmacists (ASHP) [Internet]. [cited 2010 March 24]. Available from: <http://www.ashp.org/menu/PracticePolicy/ResourceCenters.aspx>
52. Burt B, Research, Science and Therapy Committee of the American Academy of Periodontology. Position Paper: Epidemiology of Periodontal Diseases. *J Periodontol.* 2005; 76(8): 1406-1419