MANAGEMENT & MARKETING

(Editor's Note: This quarterly JCO column is compiled by Contributing Editor Robert Haeger. Every three months, Dr. Haeger presents a successful approach or strategy for a particular aspect of practice management. Your suggestions for future topics or authors are welcome.)

Improving treatment efficiency and office productivity through well-designed practice analysis should be the goal of every clinician. Over the next few years, this Management and Marketing column will focus on the statistical analysis of treatment techniques, mechanics, appliances, and practice monitoring systems. I have worked with Dr. Roger Colberg, a professor of statistics specializing in product development, to analyze my own practice in three main areas: the initial examination appointment, dentist referral patterns, and results of marketing campaigns; recall systems, no-show rates, and treatment delays; and treatment efficiency, appointment intervals, bracket systems, and length of treatment for specific malocclusions. As a result, I have made many changes in my practice, reducing treatment times by four to six months overall.

We have also analyzed data from the orthodontists of the Super Schulman Group, a club of high-performing practices founded by consultant Bud Schulman. Their average figures will be included in the articles when applicable.

This introductory column will analyze the effects of missed appointments, loose brackets, and repositioned brackets on treatment efficiencies. Using similar statistical analyses, future articles will analyze the economics of multiphase vs. full treatment; recall no-show rates for various time intervals and months of the year; results of initial exams and treatment coordinator procedures; and the effects of indirect bonding, self-ligating brackets, extractions, expanders, and many more methods and appliances.

Please feel free to submit any of your own analytic systems and results that might make a productive contribution to our profession.

ROBERT S. HAEGER, DDS, MS

Effects of Missed Appointments and Bracket Failures on Treatment Efficiency and Office Productivity

The data for this analysis came from 725 consecutively debonded patients in my practice. The most important variables were defined as described below:

Age: Anyone under 19 years old was categorized as a child.

Molar classification: This can be difficult to standardize, but we considered a molar relationship that was 30% or less Class II to be a Class I (Fig. 1). A 100% Class II was a full-cusp Class II molar relationship, while a 50% Class II was one with a flush terminal plane. The rationale for classifying

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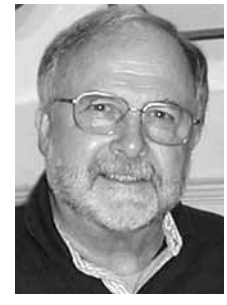

Dr. Colberg

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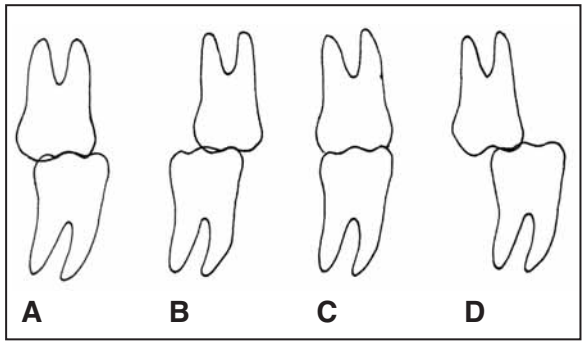

Fig. 1 Molar classifications. A. Class I (30% or less Class II). B. 100% Class II. C. 50% Class II. D. 100% Class III.

slightly Class II molars as Class I is that they treat more like Class I problems and require limited Class II mechanics. In fact, many Class II cases are actually Class I malocclusions that have yet to express mandibular molar drift into the leeway spaces or rotated maxillary first molars.

Missed appointments: The total number of "no-show" visits, not including rescheduled appointments.

Loose brackets: The number of brackets that became dislodged during treatment. No differentiation was made between patient and office culpability.

Repositioned brackets: The number of brackets that the orthodontist decided to replace due to improper root angulations, torque, crown rotations, or vertical positions.

Treatment time: The number of months it took to treat the patient, from appliance placement to debonding.

Number of active appointments: The total number of actual office visits, including bonding and debonding. Emergency visits were not counted as active appointments unless a bracket was rebonded, a new chain was added, or something else was done to make progress toward finishing.

Methodology

Isolating the effects of a single variable is one of the most difficult challenges in clinical orthodontic research. To accomplish this, we excluded all patients with extractions, expanders, missing permanent teeth, impactions, or Class III molar relationships of any percentage, as well as transfers, surgical cases, and a few extreme outliers. This reduced our sample size to 398 patients. Three different assistants tabulated the results. Several discussions and reviews of the data took place along the way to help us standardize our procedures.

The treatment for each patient involved bidimensional American vertical-slot brackets* on all teeth, except for bands on the upper first molars. The brackets were all bonded directly using Reliance light-cured adhesive.**

Results

Table 1 shows the effects of missed appointments and bracket failures in a *univariate analysis,* with each variable isolated as if it were an independent event. Although the average length of treatment was 18.3 months, the treatment period dropped to 17.3 months if there were no missed appointments, but increased to 20.0 for patients who missed one or more appointments (Table 1A). Similarly, the average number of appointments was 13.8, but this dropped to 13.4 if no appointments were missed and increased to 14.5 if one or more were missed. Patients with loose brackets averaged 2.8 more months in treatment and 1.5 more visits than those with no loose brackets (Table 1B). Patients with repositioned brackets averaged 5.5 more months and 3.7 more visits than those with no repositioning (Table 1C).

Regression analysis was used to isolate the effects of each missed appointment, loose bracket, or repositioned bracket. Every missed appointment added 1.73 more months and .68 more appointments to a patient's treatment (Table 2A). Every loose bracket added 1.21 months and .77 appointments (Table 2B). The first repositioned bracket added 2.78 months and 1.94 appointments to treatment, but each subsequent repositioned bracket added only another .87 months and .58 vis-

*American Orthodontics, Inc., 1714 Cambridge Ave., Sheboygan, WI 53082; www.americanortho.com.

**Reliance Orthodontic Products, Inc., P.O. Box 678, Itasca, IL 60143; www.relianceorthodontics.com.

TABLE 1
EFFECTS OF MISSED APPOINTMENTS AND BRACKET FAILURES (UNIVARIATE ANALYSIS)

	No. Patients	Treatment Time (months)	No. Appointments
All patients	398	18.3	13.8
A. No missed appointments	258	17.3	13.4
1 or more missed appointments	140	20.0	14.5
B. No loose brackets	203	16.9	13.1
1 or more loose brackets	195	19.7	14.6
C. No repositioned brackets	119	14.4	11.2
1 or more repositioned brackets	279	19.9	14.9

TABLE 2
INCREMENTAL EFFECTS OF MISSED APPOINTMENTS AND BRACKET FAILURES (REGRESSION ANALYSIS)

	Treatment Time (months)	No. Appointments
A. No missed appointments	17.29	13.43
Increase for each missed appointment	1.73	0.68
B. No loose brackets	17.10	13.08
Increase for each loose bracket	1.21	0.77
C. No repositioned brackets	14.44	11.21
Increase for first repositioned bracket	2.78	1.94
Increase for each additional repositioning	0.87	0.58

TABLE 3
INCREMENTAL EFFECTS OF MULTIPLE EVENTS (MULTIVARIATE ANALYSIS)

	Treatment Time (months)	No. Appointments
No events	13.86	11.08
Increase for each missed appointment	1.31	0.38
Increase for each loose bracket	0.79	0.56
Increase for each repositioned bracket	1.02	0.70

TABLE 4
IMPACT ON TREATMENT TIME (MONTHS)

	No Events	Missed Appointments	Loose Brackets	Repositioned Brackets	Total
Median No.		1	1	4	
All Patients (N = 398)					
Coefficient		1.31	0.79	1.02	
Impact	13.86	1.31	0.79	4.09	20.05
Class I Children (N = 99)					
Coefficient		1.14	0.16	0.98	
Impact	13.69	1.14	0.16	3.92	18.91
Class II Children (N = 131)					
Coefficient		1.07	0.90	0.60	
Impact	17.85	1.07	0.90	2.40	22.22
Class I Adults (N = 35)					
Coefficient		0.00	0.00	1.04	
Impact	14.96	0.00	0.00	4.16	19.12

TABLE 5
IMPACT ON NUMBER OF ACTIVE APPOINTMENTS

	No Events	Missed Appointments	Loose Brackets	Repositioned Brackets	Total
Median No.		1	1	4	
All Patients (N = 398)					
Coefficient		0.38	0.56	0.70	
Impact	11.08	0.38	0.56	2.79	14.81
Class I Children (N = 99)					
Coefficient		0.25	0.17	0.72	
Impact	10.61	0.25	0.17	2.88	13.91
Class II Children (N = 131)					
Coefficient		0.00	0.64	0.36	
Impact	14.05	0.00	0.64	1.44	16.13
Class I Adults (N = 35)					
Coefficient		0.00	0.00	0.82	
Impact	11.65	0.00	0.00	3.28	14.93

its (Table 2C).

Because any one patient is likely to experience a combination of events, a *multivariate regression analysis* was also conducted (Table 3). Here, the added treatment time was 1.31 months for each missed appointment, .79 for each loose bracket, and 1.02 for each repositioned bracket. The additional number of active visits was .38 for each missed appointment, .56 for each loose bracket, and .70 for each repositioned bracket.

Armed with this information, we were able to construct models for our patients in various categories (Table 4). The typical patient in my office had one missed appointment, one loose bracket, and four repositioned brackets. When these median figures were multiplied by the coefficients of 1.31 months for each missed appointment, .79 months for each loose bracket, and 1.02 months for each repositioned bracket, the treatment time increased from 13.86 months with no events to 20.05 months with the typical number of events. In other words, if we could have fully controlled these variables, we could have reduced treatment time by more than six months. Similar calculations were made for three subgroups of full-treatment nonextraction cases: Class I children, Class II children, and Class I adults.

The average number of appointments with no events was 11.08, but the typical patient had 3.73 more appointments because of missed appointments, loose brackets, and repositioned brackets (Table 5). The total effect of these variables was slightly less for Class II children, adding only about two visits to treatment. Missed appointments added no appointments for either Class II children or Class I adults. Loose brackets also had no effect on the number of visits for Class I adults. Repositioned brackets had the greatest impact on the number of appointments in all three subgroups.

Discussion

This analysis of patients from my practice shows that bracket repositioning is the single most important factor in impoving treatment efficiency and productivity. The data indicate that we could be spending two to four extra months treating a Class I or II patient because of our own mistakes in bracket placement.

The monetary impact of eliminating repositioned brackets is somewhat determined by patient backlog; if you have patients to fill the open appointment slots, the financial return gained by eliminating 2.8 visits per patient can be substantial. If you don't have a backlog of patients, you can still gain time to plan and implement marketing strategies, or simply to spend at home. You may also be able to reduce the size of your staff.

This model can be the starting point for evaluating new products and techniques. Does indirect bonding help? Does the number of repositioned brackets differ between conventional cast setups and digital models? How much time is added to treatment by starting before full eruption of the maxillary canines?

Future research and development should focus on methods that can reduce or eliminate bracket repositioning. For example, if accessing a tooth with a laser could save one repositioning, that would amount to one month in treatment and .7 appointments. Does the Insignia*** system help avoid errors by allowing the clinician to visualize treatment results based on bracket placement? Does SureSmile† improve efficiency by approaching the issue from a different direction, making adjustments to the archwire rather than the brackets?

I believe the future of orthodontics revolves around bracket placement. Imagine taking a cone-beam image of a patient and simply e-mailing it to the orthodontic supplier. Imagine a virtual setup on the computer with full three-dimensional root alignment, producing indirect-bonding trays with individualized brackets for torque control. These tools may not be available today or tomorrow, but they are coming sooner than we might think.

***Trademark of Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867; www.ormco.com.

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