A Systematic Approach to the Interpretation of Tooth Mobility and Its Clinical Implications

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Tooth mobility can have significant clinical implications for dental treatment. This one clinical finding may be the decisive factor that determines whether dental treatment of any kind is undertaken. Prior to treatment, the dentist must decide whether the pattern and degree of observed tooth mobility is reversible or irreversible. This decision and its implications for retention and treatment or extraction and replacement are only as valid as the dentist's total understanding of the pathologic processes causing the observed tooth mobility.

The purpose of this article is to present a systematic approach to the interpretation of tooth mobility so that its reversibility or irreversibility can be more predictably established. This clinical approach is founded upon a histologic awareness of the active pathologic processes causing tooth mobility. From this biologic background, a new integration of commonly used clinical findings is developed. New concepts are presented in an effort to provide important clinical linkages between scattered clinical findings, so that a clearer understanding of the marked variability of tooth mobility emerges with clearer implications for treatment.

DEFINITION OF PATHOLOGIC TOOTH MOBILITY

All teeth that are fully formed, fully erupted, fully supported by alveolar bone, and in full occlusion with an antagonist, should be firm and immobile. Pathologic tooth mobility is any degree of perceptible movement of a tooth faciolingually, mesiodistally, or axially when a force

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is applied to the tooth. That force is applied to a tooth by rocking it between the handles of two instruments or a combination of fingers and instruments. The determination of pathologic tooth mobility is a clinical exercise. Physiologic tooth mobility does not exist clinically. It is only an experimental determination of tooth displacement using extremely sophisticated (but cumbersome) measuring devices to record tooth displacements in the range of one hundredths of a millimeter.

CAUSES OF PATHOLOGIC TOOTH MOBILITY

Two pathologic processes are active in causing tooth mobility: plaque-induced inflammatory disease and excessive occlusal forces. The marked variability in tooth mobility seen clinically reflects the varying severity of periodontal involvement caused by either of these processes acting singly and independently or acting together and co-destructively. The clinical variability of tooth mobility is further complicated by varying levels and kinds of alveolar bone loss produced by each of these processes.

Fortunately, the clinical finding of deep periodontal pockets is unique to plaque-induced inflammatory disease. Occlusal dysfunction does not produce periodontal pockets. Therefore, elimination of periodontal pockets by definitive periodontal treatment and optimal procedures for plaque control practiced by the patient should establish total control of plaque-induced inflammatory disease and related alveolar bone loss.

With control of this variable, any residual tooth mobility must be concluded to be the result of excessive occlusal forces alone. The amount of remaining alveolar bone support is clinically important, since it determines the capacity of the remaining attachment apparatus to reverse existing tooth mobilities. Alveolar bone height sustained at or near the cemento-enamel junction (CEJ) will not keep a tooth from becoming loose if it is subjected to excessive occlusal forces, but it will determine the potential to reverse that mobility by occlusal adjustment techniques and other restorative procedures.

HISTOLOGIC IMPLICATIONS OF TOOTH MOBILITY

The tensions and pressures of excessive occlusal forces transmitted to the periodontal ligament produce molecular and physicochemical alteration of the ground substance and fibrous component of this tissue. This results in qualitative and quantitative changes seen histologically as a typical tissue response to injury with atrophic, degenerative and necrotic changes in the periodontal ligament. The wide variability of tooth mobility can be directly correlated with the varying severity of injury. Ultimate success in controlling tooth mobility depends on the ability to reverse these atrophic, degenerative, and necrotic changes.

Figure 1 shows the importance of sustaining a quality and quantity of alveolar bone or "a critical mass of alveolar bone," that can separate the zones of pressure and tension that are created by simple, unilaterally directed tipping forces at the cervical third and apical third of the root. These separate zones of pressure and tension and the tissue changes they represent are more easily reversible, since they reflect the earliest response of the periodontal tissue to excessive occlusal forces. Histologically, there is increased compression and tension of the periodontal ligament. In the zone of pressure, there is increased osteoclasis of alveolar bone, and in the zone of tension, there is increased osteoblastic activity.

But these "pure" zones of pressure and tension can be transformed by bruxing and clenching habits into more destructive zones of crush. If such habits are present, the unilaterally directed tipping force is replaced by a rocking force faciolingually, and the magnitude of the force is increased as well as its frequency and duration. Depending on the intensity of these changes, a more extreme and varied tissue response occurs. With greater pressure and tension, the zone of crush shows changes in the periodontal ligament, beginning with compression of

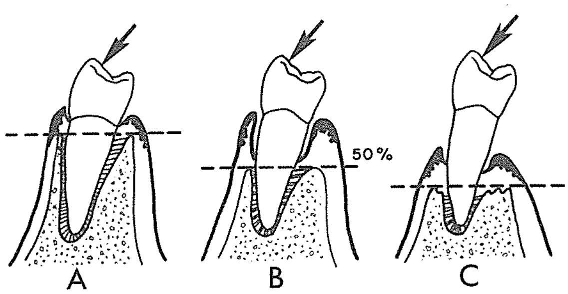

Figure 1. Unilaterally directed "tipping" forces create separate zones of pressure and tension at the cervical and apical third of the root. In contrast to this "tipping" force, a "rocking" force, such as occurs in a bruxing or clenching habit, causes the zones of pressure and tension to commingle into zones of crush. *A,* With crestal alveolar bone height maintained at or just below the cemento-enamel junction, the injury is fully reversible if the force is relieved or the tooth moves away from the tipping force. *B,* With the development of moderate periodontitis characterized by 50 per cent alveolar bone loss, the zones of pressure and tension at the crestal third are moved closer to the zones of pressure and tension at the apical third. The capacity of the attachment apparatus to reverse an injurious tipping force is less predictable at this level of periodontal support. *C,* A tooth with alveolar bone support in only the apical third offers less than 20 to 25 per cent of root surface area for attachment, so that a critical mass of alveolar bone fails to intervene between the crestal third zones of pressure and tension and the apical third zones of pressure and tension, resulting in total confluence of the injury producing one continuous zone of crush throughout the remaining attachment apparatus. The clinical result is irreversible pathologic tooth mobility.

fibers that produces areas of hyalinization. Continued injury to the fibroblasts and other elements of the connective tissue leads to necrosis of areas of the ligament. With severe tension, widening of the periodontal ligament occurs, with thrombosis, hemorrhage, tearing of the periodontal ligament, and resorption of alveolar bone.

Injury of this intensity is associated with a temporary depression in mitotic activity and the rate of proliferation and differentiation of fibroblasts, collagen, and alveolar bone. The clinical manifestation of this histologic response can be extremely variable tooth mobilities. The goal of dental therapy is to undertake those definitive procedures that will dissipate these injurious forces, restore the normal integrity of the periodontal tissues, and reduce extreme tooth mobilities.

CLINICAL IMPLICATIONS OF TOOTH MOBILITY

The clinical implications of these histologic changes are clear: if a tooth can be free to move away from a source of excessive occlusal stress, then the periodontal tissues possess the incredible capacity for repair and regeneration that will then reverse any degree of tooth mobility. But this capacity for repair and regeneration is not unlimited.

There is a critical point at which the periodontal ligament loses its unique capacity for favorable changes, so that irreversible tissue changes occur and irreversible tooth mobility results. This critical point is reached when crestal alveolar bone height is reduced to a level approaching the apical third of the root (see Fig. 1). Now the obvious severe quantitative reduction of alveolar bone support simply exhausts the capacity of the periodontal ligament to adapt qualitatively in order to negate the traumatizing force. This is understandable as the tapering anatomy of the apical third of the root may make available only 15 to 20 per cent of the total surface area of the root for effective attachment.

At this critical level, horizontal loading of a tooth (possibly related to primary trauma from occlusion, such as bruxing or clenching, or secondary trauma from occlusion) creates a zone of combined pressure and tension, or zone of crush, at the crestal-third area that may be superimposed on or continuous with that zone of crush occurring at the apical-third area. In effect, the entire periodontal ligament becomes subject to hemorrhage and thrombosis, with degeneration and necrosis of the ground substance and collagenous fibers of the periodontal ligament, and resorption of the entire remaining intra-alveolar supporting bone. The periodontal ligament is unable to undergo any degree of reparative or regenerative change, and tooth mobility persists irreversibly.

DEFINITION OF CRITICAL MASS OF ALVEOLAR BONE SUPPORT

Just as there is an apical-third level of alveolar bone that is inadequate to stabilize a tooth, there is a level of alveolar bone support, although reduced, that will permit tooth mobility to be reversed. This level of alveolar bone, which is unique to each tooth, is defined as the critical mass of alveolar bone support. It is that quantity and quality of alveolar bone that sustains a separation of the crestal-third and apical-third zones of crush and allows for physiologic adaptive changes to occur that mediate reparative and regenerative processes that reduce or eliminate tooth mobility.

Such a level of alveolar bone support obviously exists, for every clinician has seen firm and immobile teeth that possess significantly reduced alveolar bone support. But what is that critical level of alveolar bone support that can permit the periodontal ligament to undergo repair and regeneration? It exists when at least 50 per cent or more of the total root length remains embedded in supporting alveolar bone. Anatomically, this level can be defined for each tooth. A review of root morphology in Wheeler will show that root contours are not perfect cones.[4] Extending apically from the cemento-enamel junction for approximately 5.0 to 6.0 mm, root structure remains broad and almost rectangular, then begins to taper to the apex. Alveolar bone support remaining below the cervical-third but at the middle half of the root should still provide more than 40 to 50 per cent of the total root surface area for attachment. Even at this reduced level of alveolar bone support, it is possible that a critical mass of alveolar bone support can be maintained between the crestal-third and the apical-third zones of crush so that the two are not continuous around the remaining root length. Thus, the critical mass of alveolar bone support provides a viable zone of periodontal tissue that maintains a source of healthy tissue for repair and regeneration of the traumatized tissue once the traumatizing force is dissipated.

CLINICAL DETERMINATION OF A CRITICAL MASS OF ALVEOLAR BONE SUPPORT

The determination that a critical mass of alveolar bone support exists can be established by probing and charting the depths of periodontal pockets, which are then correlated with radiographic evidence of alveolar bone loss. The percentage of remaining alveolar bone is calculated by relating the amount of lost periodontal support reflected by the depths of periodontal pockets to the total root length. Root length and contour may be visualized from the periapical radiograph or determined from a review of dental anatomy (Table 1). For example, if the absolute depths of periodontal pockets on the mesial aspect of the maxillary central incisor are 6.0 to 7.0 mm and the root length of this tooth is 13.0 mm, then approximately 50 per cent loss of alveolar bone has occurred on this surface.

In this way, the pattern of alveolar bone support around each tooth can be charted from the depths of periodontal pockets and confirmed by radiographic evidence. The percentage of alveolar bone remaining or lost can be established for each surface of each tooth. If 50 per cent or more of the existing root surface of a single-rooted tooth is supported by alveolar bone, then a critical mass of alveolar bone support is present around that tooth. This is not true for multi-rooted teeth, since loss of 50 per cent of the alveolar bone would be accompanied by advanced furcation involvement. Instead, alveolar bone support around molar teeth would need to be sustained at about the cervical-third of the tooth.

Table 1. *Root Surface Area and Root Length of Four Tooth Types Correlated with Approximate Periodontal Pocket Depths Producing 50 Per Cent Alveolar Bone Loss*

	ROOT SURFACE AREA* (SQ MM)	ROOT LENGTH† (MM)	PERIODONTAL POCKET DEPTH (MM)
Tooth Type I			
Mandibular central incisors	154	12.5	6.0
Mandibular lateral incisors	168	14.0	7.0
Maxillary lateral incisors	179	13.0	6.0-7.0
Mandibular first premolars	180	14.0	7.0
Tooth Type II			
Maxillary central incisors	204	13.0	6.0–7.0
Mandibular second premolars	207	14.5	7.0
Maxillary second premolars	220	14.0	7.0
Maxillary first premolars	234	14.0	7.0
Tooth Type III			
Mandibular cuspids	268	16.0	8.0–9.0
Maxillary cuspids	273	17.0	8.0–9.0
Tooth Type IV			
Mandibular second molars	426	M: 13.0 D: 13.0	6.0–7.0
Mandibular first molars	431	M: 14.0 D: 14.0	7.0
Maxillary second molars	431	B: 11.0 P: 12.0	5.0–6.0
Maxillary first molars	433	B: 12.0 P: 13.0	6.0–7.0

*Adapted from Jepsen.[1]
†Adapted from Wheeler.[4]

Molar root anatomy often varies in this area since the root trunk area may be of unpredictable width, influencing the level of root separation.

Four Stages of Alveolar Bone Loss Defined

To simplify the evaluation and reference to the percentage of alveolar bone loss around each tooth, four stages of alveolar bone loss can be described as follows:

Stage N: No radiographic evidence of alveolar bone loss or an intact crestal height of alveolar bone at or just below the cemento-enamel junction.

Stage I: Radiographic evidence of alveolar bone loss reflecting the range of 10 to 30 per cent of lost periodontal support.

Stage II: Radiographic evidence of alveolar bone loss reflecting the range of 30 to 60 per cent of lost periodontal support.

Stage III: Radiographic evidence of alveolar bone loss greater than 66 per cent (or alveolar bone support remaining only at the apical-third of the root).

These four stages are not arbitrarily defined but relate specifically to the four case patterns described in the publication, *Current Procedural Terminology for Periodontics* by the American Academy of Periodontology.[5] Four typical case patterns are presented as follows:

Type I. Gingivitis (Stage N): Inflammation of the gingiva characterized clinically by gingival hyperplasia, edema, retractability, gingival pocket formation, and no bone loss.

Type II. Early Periodontitis (Stage I): Progression of gingival inflammation into the alveolar bone crest and early bone loss resulting in moderate pocket formation.

Type III. Moderate Periodontitis (Stage II): A more advanced state of the above condition, with increased destruction of periodontal structures associated with moderate to deep pockets, moderate to severe bone loss, and tooth mobility.

Type IV. Advanced Periodontitis (Stage III): Further progression of periodontitis, with severe destruction of the periodontal structures with increased tooth mobility.

In this classification, four different levels of alveolar bone loss are described: no bone loss, early, moderate, and severe. Stages N, I, II, and III simply attach a specific range of percentages of bone loss that can then be more simply estimated, described, and compared. For example, a mandibular central incisor with Stage I bone loss and 1+ mobility has a better prognosis than the same tooth with Stage II bone loss and the same mobility.

Crown and Root Morphology and Classification of Four Tooth Types

If a dentist merely assigns a degree of mobility to a tooth without considering the specific tooth involved or the stage of alveolar bone loss, then that clinical exercise is meaningless. Each tooth has unique crown and root morphology that determines its own unique critical mass of alveolar bone support. Ritchey and Orban demonstrated the role of crown morphology in determining the morphology of the underlying alveolar bone.[3] If contacting crown surfaces are relatively flat, then the interproximal alveolar septa will be narrow, with more or less pointed alveolar crests and quantitatively less alveolar bone support. If contacting crown surfaces are strongly convex or bell-shaped, the interdental septa will be wide and the alveolar crests flat with quantitatively greater alveolar bone support. But even more important, root morphology will determine the square millimeters of root surface area available for attachment and the quantitative and qualitative nature of the alveolar bone support facially and lingually. Bulbous or club-shaped root contours can predispose a tooth to such thin facial alveolar bone support that fenestrations and dehiscences can occur.

Single-rooted and multi-rooted teeth vary tremendously in the amount of root surface area available for attachment and can be clearly divided into four distinct tooth types:

Tooth Type I	*Tooth Type II*
Mandibular central incisors	Maxillary central incisors
Mandibular lateral incisors	Mandibular second premolars
Maxillary lateral incisors	Maxillary second premolars
Mandibular first premolars	Maxillary first premolars
Tooth Type III	*Tooth Type IV*
Mandibular cuspids	Mandibular second molars
Maxillary cuspids	Mandibular first molars
	Maxillary second molars
	Maxillary first molars

A differentiation of tooth types according to root surface area is shown in Table 1. This classification is based upon a study by Jepsen in which the root surface area of 238 extracted teeth was precisely measured from a photographic enlargement of a polyvinyl-chloride replica of the root structure (five times the original).[1] Figure 2 shows the mesial root morphology projected with square millimeter demarcations. The root anatomy of each tooth, in all its aspects, should always be conceptualized in this way as representing so many square millimeters of root surface area available for attachment. Therefore, an awareness of root anatomy is important as absolute periodontal pocket depths are probed around each tooth. The emerging pattern of alveolar bone loss, horizontal or angular, can be outlined around each root by the careful probing of periodontal pocket depths correlated with radiographic findings of interproximal alveolar bone height and root length. Upon completion of this meticulous clinical and radiographic evaluation of periodontal support, charting of tooth mobility can be performed.

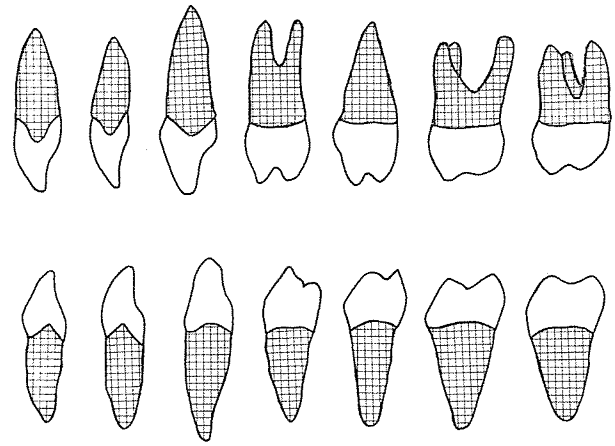

Figure 2. Root morphology must be conceptualized clinically as a finite surface area of so many square millimeters for attachment of fibers of the periodontal ligament. Resorptive changes at the apex of the root or markedly tapering or short root contours can further limit the root surface area available for periodontal support. Mesial projections of the root surface should be extended to include an awareness of the distal as well as the facial and lingual aspects of root morphology. Clinical evidence of periodontal pocket depths should then be correlated with radiographic evidence of the extent (stage) and pattern of alveolar bone loss (horizontal or angular) to establish a quantitative approximation of the amount of lost periodontal ligament attachment with its implications for pathological tooth mobility. (Adapted from Wheeler, R. C.: A Textbook of Dental Anatomy and Physiology. Edition 4. Philadelphia, W. B. Saunders Co., 1965.)

CLINICAL DETERMINATION OF TOOTH MOBILITY

The clinical evaluation of tooth mobility starts with the assignment of a degree of tooth mobility to each tooth. This requires the use of a simple scale of tooth mobilities such as the following:

Firm		Slight		Moderate		Severe	
N	+	1	1+	2	2+	3	3+

This scale assigns the degree of mobility on the basis of slight, moderate, and severe displacement. A 3+ mobility indicates that a tooth has severe horizontal movement plus apical intrusion. There is no attempt to interpret millimeters of horizontal tooth displacement.

O'Leary recognized that a simple scale such as the one above, if used consistently by the dentist, can be extremely useful clinically to determine a patient's final dental treatment.[2] A baseline entry of beginning tooth mobilities should be established for each patient at the first visit. If the starting mobilities are not recorded, then the documentation of subsequent changes in tooth mobilities will be meaningless. A record sheet is required for this ongoing monitoring of changes in tooth mobility (Fig. 3). Recording of changes in tooth mobility over an extended period of time allows a pattern of favorable or unfavorable response to emerge. Control or lack of control of each of the active disease processes causing tooth mobility is reflected by the pattern of changing tooth mobility measured and recorded over an extended period of time.

PRETREATMENT PATTERNS OF TOOTH MOBILITY

Prior to treatment, at the initial examination when individual degrees of mobility are first assigned to each tooth, four different overall patterns of tooth mobility emerge: expected, exaggerated, deceptive, and mixed. Figure 4 shows these different patterns of tooth mobility related to the stages of alveolar bone loss described above.

Expected Pattern of Tooth Mobility

Once periodontal pocket depths are known and the amount of alveolar bone support determined for each tooth type, an expected and predicted baseline level of tooth mobility can be established for each tooth. Table 2 shows a pattern of expected tooth mobilities that may be correlated with each tooth type at each of the four stages of alveolar bone loss. The expected patterns of tooth mobility generally reflect a balanced impact of both excessive occlusal forces and plaque-induced inflammatory disease upon the periodontium. If both of these pathologic

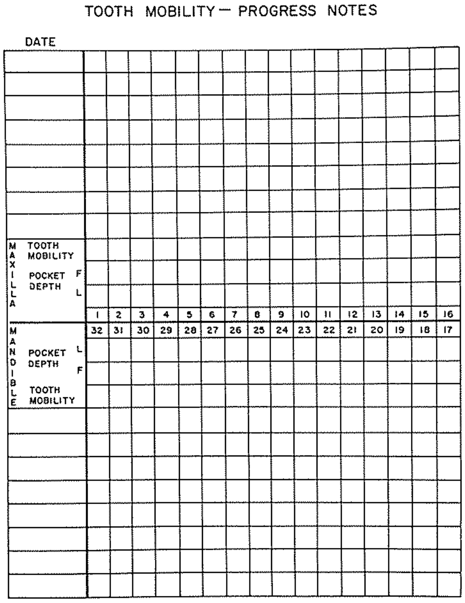

Figure 3. The key to the intelligent use of tooth mobility as a clinical finding is the documentation of its measured change through a known sequence of treatment. If tooth mobilities at the outset are slight (+, 1 or 1+), the time period for treatment may be short, but if the overall pattern of mobilities is moderate (2, 2+) to severe (3, 3+), then the time period for treatment may be quite extended. A progress record sheet allows for the continual monitoring of tooth mobility through a prolonged period of treatment.

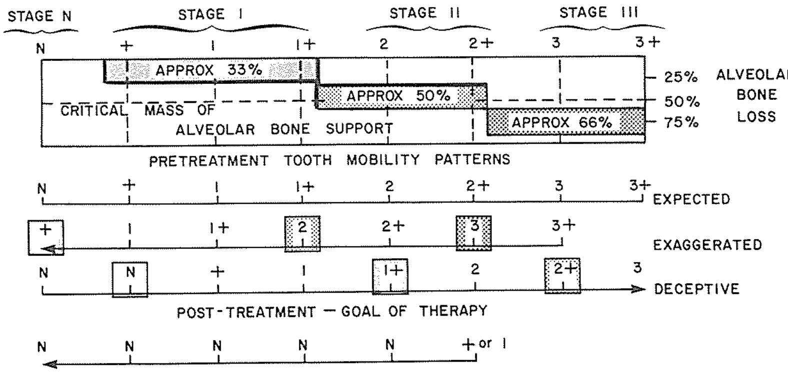

Figure 4. Varying amounts of alveolar bone loss result from the destructive impact of plaque-induced inflammation on the periodontium. This loss of periodontal support can range from an intact crestal height of alveolar bone at or just below the cemento-enamel junction (Stage N), progress to the loss of approximately 33 per cent of the alveolar bone at Stage I, to the loss of approximately 50 per cent of the alveolar bone in Stage II, and to a loss of approximately 66 per cent of the alveolar bone in Stage III. Three different pretreatment patterns of tooth mobility, expected, exaggerated, and deceptive, exist for all teeth. Here, hypothetical pretreatment patterns of tooth mobility are shown for tooth type I, which includes the mandibular central and lateral incisors as well as the maxillary lateral incisors and mandibular first premolars. This type of tooth has the smallest amount of root surface area available for attachment (average 170 square mm). The expected tooth mobilities for these teeth are consistent with the severity of bone loss: slight mobilities (+, 1, 1+) at Stage I; moderate mobilities (2, 2+) at Stage II; and severe mobilities (3, 3+) at Stage III. In contrast to the expected tooth mobilities, the boxed and shaded degrees of mobility show that exaggerated mobilities (+) can be found even with an intact periodontium (Stage N), progressing to moderate mobilities (2) at Stage I, to severe mobilities (3) at Stage II. On the other hand, deceptively low mobilities may be found with immobile teeth (N) at Stage I, only slight mobilities (1+) at Stage II, or moderate mobilities (2+) at Stage III. Knowing when deceptively low or exaggeratedly high mobilities exist compared to expected degrees of tooth mobility can permit critical differentiation of the causative factors requiring treatment. If a critical mass of alveolar bone support is present, that is, Stages N, I, or II, then there should be every expectation that all existing degrees of tooth mobility can be reversed with a return to tooth immobility (N) or only slight mobility (+ or 1).

processes can be controlled, then all teeth with a critical mass of alveolar bone support should be returned to a state of firmness and immobility, or at the most, a slight degree of mobility (+ or 1), at the conclusion of dental treatment.

Exaggerated Pattern of Tooth Mobility

Exaggerated tooth mobility (or unexpected tooth mobility) is that degree of increased tooth displacement beyond what might be predicted and expected based upon the depth of periodontal pockets and the amount of remaining alveolar bone support reflected radiographically. An exaggerated pattern of tooth mobility may be correlated with the four specific tooth types and four stages of alveolar bone loss (see Table 2). Any unusual increase in tooth mobility beyond an expected level may

Table 2. *Correlation of Hypothetical Patterns of Tooth Mobility with Different Tooth Types and Different Stages of Alveolar Bone Loss*

	STAGE N			STAGE I BONE LOSS			STAGE II BONE LOSS			STAGE III BONE LOSS		
	Decept.	*Expect.*	*Exagg.*	*Decept.*	*Expect.*	*Exagg.*	*Decept.*	*Expect.*	*Exagg.*	*Decept.*	*Expect.*	*Exagg.*
Tooth Type I Mandibular central incisors Mandibular lateral incisors Maxillary lateral incisors Mandibular first premolars (Average: 170 mm^2)	N	N	1	N	1, 1+	2	1+	2, 2+	3	2+	3, 3+	3+
Tooth Type II Maxillary central incisors Mandibular second premolars Maxillary second premolars Maxillary first premolars (Average: 232 mm^2)	N	N	1	N	+, 1	1+	+	1	2	1+	2+	3
Tooth Type III Mandibular cuspids Maxillary cuspids (Average: 270 mm^2)	N	N	+	N	N	+, 1	N	N, +	1, 1+	+, 1	1+	2
Bone Loss—Furca Inv.	STAGE N—GRADE I			STAGE I—GRADE II			STAGE II—GRADE III			STAGE III—GRADE IV		
Tooth Type IV Mandibular second molars Mandibular first molars Maxillary second molars Maxillary first molars (Average: 430 mm^2)	N	N	1	N	N	1	N	+	1+	1	2	2+

signal the activity of a parafunctional habit, either bruxism or clenching. Depending upon the intensity of the habit, despite full control of plaque-induced inflammatory disease and total absence of periodontal pocket involvement, exaggerated tooth mobilities may not be fully controllable.

Deceptive Pattern of Tooth Mobility

Deceptive tooth mobility is that degree of tooth displacement that is less than expected considering the depth of periodontal pockets and the amount of remaining alveolar bone support around specific teeth. A deceptive pattern of tooth mobility may be associated with the four stages of alveolar bone loss and the four specific tooth types. In general, the goal of dental therapy is to achieve lower tooth mobilities than may be expected for a given level of alveolar bone support. Deceptively low tooth mobilities at the outset of treatment should, in general, signal a good prognosis for single-rooted teeth. However, there should be greater concern about mobile molar teeth, which often have deceptively low mobilities because one root may be sufficiently uninvolved periodontally to stabilize the entire tooth, despite severe involvement about the remaining root (or roots). Therefore, molar teeth with any degree of mobility often have a guarded prognosis throughout treatment.

Mixed Pattern of Tooth Mobility

As in any biologic system, it is rare that an individual dentition reflects entirely one overall pattern of tooth mobility. More often, a mixed pattern of mobilities is evident clinically. If a parafunctional habit is active, the teeth most involved in that habit will exhibit exaggerated degrees of mobility. Molar teeth will tend to have deceptively low mobility if one or more roots remain relatively uninvolved. Thus, overall, a generalized pattern of expected mobilities may exist, but individual teeth may show exaggeratedly greater mobility and others deceptively low mobility. It is exactly this known variation from an expected level of mobility that can permit a critical differentiation of the factors causing that mobility.

IMPLICATIONS OF TOOTH MOBILITY FOR PROGNOSIS AND TREATMENT

The implication of tooth mobility for the prognosis and treatment of single-rooted teeth is significantly different from that for molar teeth because of the topography of the furcation area. However, even among different single-rooted teeth, varied tooth mobility may have different clinical implications for treatment (Fig. 5).

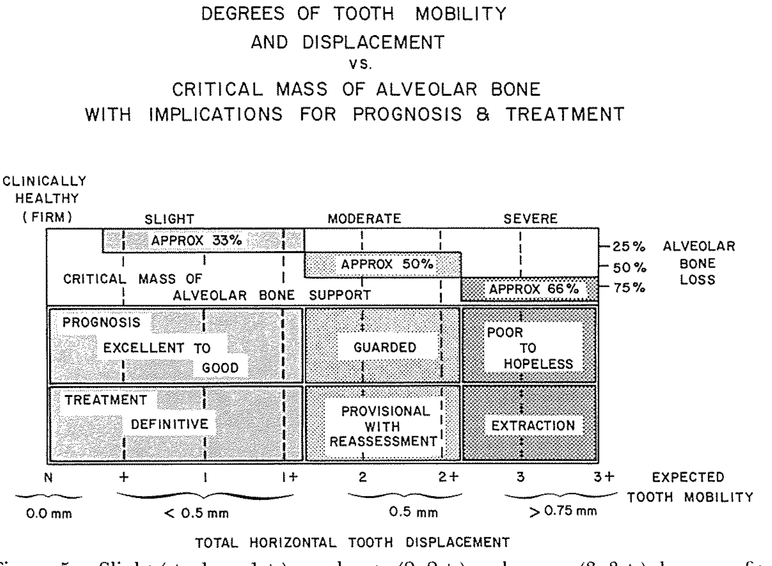

Figure 5. Slight (+, 1, or 1+), moderate (2, 2+) and severe (3, 3+) degrees of tooth mobility may be correlated with extremely small amounts of total horizontal tooth displacement (0.5 mm to 0.75 mm). If a critical mass of alveolar bone support remains, then there is retention of at least 50 per cent or more alveolar bone support. Full reversal of all degrees of detectable tooth mobility should occur. A prognosis of excellent to good exists when the mobility of single-rooted teeth is slight (+, 1 or 1+) with definitive periodontal and restorative treatment indicated. The prognosis becomes somewhat more guarded when alveolar bone loss is approximately 50 per cent, contributing to moderate tooth mobilities (2 or 2 +). At this stage, provisional treatment over an extended period of time is indicated with continual reassessment of the changing or unchanging pattern of tooth mobilities. At more advanced levels of alveolar bone loss in which periodontal support is reduced to the apical-third portion of the root, the prognosis for treatment is poor to hopeless, and extraction is indicated.

Implications of Tooth Mobility for Single-Rooted Teeth

A review of Table 2 shows the wide variability of mobility that should be expected for each tooth type at the different stages of alveolar bone loss. A significant factor in this variability is the difference in root surface area represented by each of the tooth types. If the hypothetical tooth mobilities that exist for Tooth Type I, which has the smallest root surface available for attachment (an average of 170 mm^2), can be reversed almost totally when a critical mass of alveolar bone support remains, then the mobility of Tooth Types II and III can also be significantly reduced because of their greater root surface area (230 mm^2 and 270 mm^2, respectively).

The patterns of tooth mobilities seen in Table 2 are only hypothetical. They are not absolute values. They are assumed in order to demonstrate that tooth mobility can be correlated with specific tooth types and stages of alveolar bone loss that result in "expected" degrees of tooth mobility. Any variation from that expected level of mobility resulting in lower degrees of mobility (deceptive) or greater degrees of mobility (exaggerated) becomes helpful clinically in estimating the resistance of the remaining periodontal support to injury (lower mobility pattern than expected) or the vulnerability of the remaining attachment apparatus to a persisting occlusal problem such as bruxism or clenching (producing greater degrees of mobility than expected).

Table 1 also demonstrates that Tooth Types II and III possess greater capacity for resistance to periodontal injury. This table correlates the root surface area of the ten different single-rooted teeth with periodontal pocket depths producing alveolar bone loss. It shows that, in general, absolute periodontal pocket depths of 6.0 to 7.0 mm measured from the cemento-enamel junction can reflect 50 per cent alveolar bone loss, or Stage II support. The only exception is the maxillary and mandibular cuspid teeth. These teeth may require 8.0 to 9.0 mm periodontal pocket depths before Stage II support is reached because of their increased root length.

A 6.0 to 7.0 mm periodontal pocket around Tooth Type I, which has an average total root surface area of 170 mm^2 available for attachment, would leave approximately 80 to 85 mm^2 of remaining root surface area available for support. This results in the expected moderate tooth mobilities of 2 or 2+.

Similar 6.0 to 7.0 mm periodontal pocket involvement around Tooth Type II, which has an average total surface area of 232 mm^2, will still leave approximately 116 mm^2 when 50 per cent alveolar bone loss has occurred. This is almost one and one-half times the surface area of Tooth Type I at the same stage of bone loss.

Finally, 8.0 to 9.0 mm periodontal pocket depths around Tooth Type III (cuspids), which has approximately 270 mm^2 of total root surface area, will still leave approximately 135 mm^2 of surface area for attachment, which is more than one and one-half times that of Tooth Type I at Stage II alveolar bone loss. In general, this means that the prognosis for maxillary premolars and cuspids and mandibular second premolars and cuspids is significantly better than for Tooth Type I because they have a greater surface area for attachment. If the prognosis is guarded for Tooth Type I at Stage II alveolar bone loss, then it can be expected to be at least good for Tooth Types II and III at the same stage of alveolar bone loss. This assumes that the pattern of horizontal or angular alevolar bone loss is not extreme around any one surface of these teeth and that the existing root morphology is within normal limits without short, tapering root structure or root resorptive changes.

Implications of Tooth Mobility for Multi-Rooted Teeth

Tooth mobility can be most variable and even nonexistent when molar teeth with advanced alveolar bone loss and furcation involvement are evaluated. Table 2 reflects this incredible variability of molar teeth.

Even at Stage II or III alveolar bone loss with Grade III or IV furcation involvement, tooth mobilities can be deceptively low (only slight or + or 1). What would ordinarily provide a critical mass of alveolar bone support for a single-rooted tooth often fails to provide the same support for a multi-rooted tooth.

Therefore, tooth mobility alone cannot be relied upon as the sole clinical criterion in the evaluation of multi-rooted teeth for retention and treatment. Instead, the overriding clinical determinant of whether a molar with furcation involvement can be retained intact or in part, through root amputation or hemisection, is the ability of the patient to maintain the remaining periodontal tissues free of plaque, and, therefore, free of caries and inflammation.

Every effort should be made to maintain all molar teeth intact. Molar teeth were meant to be multi-rooted in order to sustain the heavy occlusal pressures generated by the muscles of mastication. If furcation involvement demands intervention, then hemisection of a mandibular molar is preferable to a root amputation on a maxillary molar tooth. Mandibular molar teeth with intact alveolar bone support around one root can be "premolarized" to serve as distal abutments for a fixed splint. The reason for this can be seen in Table 1. Mandibular molar teeth (Tooth Type IV) with intact root structure possess approximately 430 mm^2 of root surface area for attachment. When mandibular molar teeth are hemisected, assuming approximately equal distribution of root surface area between the mesial and distal roots, the remaining root still possesses approximately 215 mm^2 of root surface area for attachment. This is more available root surface area than the root of a maxillary central incisor or mandibular second premolar and only slightly less than that of a maxillary first or second premolar. On the other hand, when the two buccal roots of a maxillary molar are resected, the remaining palatal root structure only possesses approximately 144 to 150 mm^2 of root surface area for attachment. This is less than that of the mandibular central incisors.

In addition, maxillary molar teeth pose a more difficult conversion. Single-root amputations still leave the maxillary molar prone to continued furcation involvement as the same inciting factors of inflammation and occlusal dysfunction can continue to be active. Furthermore, it is impossible to judge the extent of destruction of alveolar bone deep in the furca of a maxillary molar. Often, what appears to be an intact palatal root has extreme loss of alveolar bone on its facial aspect. Any root amputation procedure of a maxillary molar is a drastic mutilation of the tooth. It would be better to maintain the maxillary molar intact to support a removable partial denture than to undertake root resection procedures that require splinting of the remaining tooth structure that, at the most, can only continue to have an extremely guarded prognosis.

CONCLUSION

Changing patterns of tooth mobility can be used as a clinical guide to determine the prognosis and restorative treatment of single-rooted teeth, but not multi-rooted teeth such as molars and maxillary first premolars. If tooth mobility persists despite meticulous and comprehensive periodontal treatment, then excessive occlusal forces are active. Splinting loose teeth to adjacent firm teeth is unwarranted. An unsplinted tooth at least can be further monitored for improvement, whereas the true mobility of the immobilized and splinted loose tooth cannot be accurately assessed. If parafunction is suspected, especially a nighttime bruxing habit, then a night-guard appliance can be made. This appliance permits a redistribution of occlusal forces over the entire dentition. Within a short time, teeth with moderate mobility (2 or 2+) often show improvement, with reduction to slight mobilities (+ or 1). At this time, further reassessment may determine more definitive restorative treatment.

Only when a pattern of decreasing tooth mobility emerges after intensive preliminary dental treatment can the dentist determine that he has achieved control of active disease processes. If persistent or increasing tooth mobility remains after intensive dental treatment, then the dentist can only conclude that active disease processes are still uncontrolled, and possibly uncontrollable. This critical clinical information can contribute to the decision as to whether teeth should be retained and treated, retained and maintained, or extracted.

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