Rationale for Stabilization

by
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STABILIZATION BY splinting has been used in dentistry for a variety of purposes. The object of this paper is to review the various rationales for stabilization and some of the supporting documentation. Special attention will be given to the uses of stabilization in periodontics and the evidence, or lack of evidence, to support these uses.

DEFINITIONS

Before one can even begin to discuss the subject, certain terms which appear frequently in the literature and some facts relating to them need to be defined. Terms used in this paper will conform to these definitions.

Stabilization

Stabilization of a tooth is an increase in resistance to applied force by providing reciprocal antagonisms and increasing the effective root area. The force may remain the same, but the resistance is increased.1

Splint

A splint is an appliance for immobilization or stabilization of injured or diseased parts.2 In dentistry, splinting is the joining together of two or more teeth to increase resistance to applied force through stabilization.3

Types of Splinting

There are several ways to classify splinting.4-10 The following classification is based on the duration and purpose of the splint. The time intervals given are arbitrary and may vary somewhat with the given case.

Temporary Splint. This is used on a short term basis, usually less than 6 months, and is often advocated to stabilize teeth during periodontal treatment. It may11 or may not12 lead to other types of splinting.

Provisional Splint. This type of splinting is used for a longer period of time; from several months to as long as several years. It is used for diagnostic purposes. It allows the clinician to see how teeth will respond to treatment and how missing teeth may be replaced. It usually leads to more permanent forms of stabilization.1

Permanent Splints. This is one which is to be worn indefinitely. It may be either fixed or removable.

Tooth Mobility

Tooth mobility is defined as movement of a tooth in a horizontal or vertical plane of space. All teeth have some degree of mobility which is related to the width of the periodontal ligament, root attachment area, elasticity of the alveolar process and function of the tooth.13-15. 84 Mobility may or may not be visible to the eye. Increased tooth mobility may be caused by a variety of factors including pregnancy, disease states (local and systemic), trauma (including orthodontics) and hypo- or hyperfunction.13, 14. 84 A simple, reproducible, clinical measurement for tooth mobility does not exist.16

Trauma from Occlusion

Traumatism is an injury to the periodontium caused by occlusal forces beyond the physiologic limits of adaption of the tooth.17. 19-21 Histologically, it consists of one or more of the following; cemental tears, root fractures, root resorption, hemorrhage, thrombosis and necrosis in the periodontal ligament and alveolar resorption.18 Clinically, it has been divided into primary and secondary trauma from occlusion, but here confusion sets in. There are several definitions of these terms, differing slightly17-20-22. 57 or to a larger extent.23

The definition of Prichard21 and Amsterdam20 is based on the magnitude of the force causing the damage and will be used in this paper. The injury produced in either case is the same.

Primary Trauma from Occlusion. This is the injury to the periodontium due to occluding of the teeth in nonfunctional activities.21 The muscular contraction is basically isometric and the force is large (up to 250 lb/sq in).20 The periodontium may be normal or diseased.

Secondary Trauma from Occlusion. This is the injury to the periodontium caused by normal forces of mastication and function acting on teeth that have lost a large part of their attachment apparatus.21 The muscular contraction is basically isotonic and the force is physiologic (2 to 15 lb/sq in).20

The forces in these two definitions differ not only in magnitude, but also in duration and direction. The changes seen in trauma from occlusion are generally believed to be reversible in the absence of inflammation.18. 24-28 The interrelationship of inflammation and trauma from occlusion is unclear at this time.18

Rationales for Stabilization

Based on available literature, splinting is best classified and considered according to its purpose. The following outline attempts to organize splinting as it appears in the literature and the subject will be discussed under these headings.

I. Splinting the normal periodontium.
   A. Prevention of mobility.
   B. Prevention of drifting.

II. Splinting the diseased periodontium.
   A. Prevention of mobility.
   B. Prevention of drifting.

Splinting the Normal Periodontium

This includes cases where, from a clinical point of view, the periodontium is healthy. Radiographically, signs of trauma from occlusion may be present, but pat-
terns of bone loss consistent with periodontal disease are not seen.

**Prevention of Mobility**

The general belief here is that increased tooth mobility is detrimental, and if allowed to continue, could cause other damage. The dividing line between normal mobility and mobility that should be treated varies widely.\(^5\)\(^,\)\(^3\)\(^,\)\(^5\(^a\)
Part of this is due to a lack of agreement over what mobility is physiologic and what mobility results from trauma to the periodontium.\(^3\)\(^,\)\(^5\)\(^a\)

Prichard\(^2\(^9\)\) and Kjennerud\(^1\(^6\)\) believe that the “dull” percussive test is indicative of traumatic injury to the periodontal ligament.

Amsterdam\(^3\) said that with the exception of lower incisors, any mobility visible to the eye should be considered suspect.

**Post Acute Trauma.** Stabilization here is carried out to allow repair of the injured attachment apparatus in cases of excessive displacement, the belief being that too much mobility will hamper repair and healing.\(^5\)\(^,\)\(^7\)\(^,\)\(^8\)

**Occlusal Therapy.** Occlusal interferences have been implicated in the etiology of bruxism\(^3\(^0\)\)\(^,\)\(^3\(^1\)\) and the use of occlusal splints and bite planes has been advocated in their treatment. By definition, nonfunctional forces such as those active in bruxism, also cause the changes seen in primary trauma from occlusion.

Possett\(^3\(^2\)\) reported on the effects of bite planes and splints in the treatment of patients with bruxism. He claimed that these appliances prevented damage to the teeth and periodontium. He found them effective in relieving joint and muscular symptoms in several hundred patients, but did not report on their effect on the patients’ periodontal condition.

Sugarman\(^3\(^3\)\) stated that an occlusal splint is an appliance used to brace and hold the teeth together during occlusal therapy. Its purpose is to:

- allow the patient to clench against acrylic;
- avoid occlusal wear;
- allow free jaw movement.

Other authors\(^3\(^4\)\)\(^,\)\(^3\(^5\) advocate them for similar reasons. For a more complete discussion of various types of uses of occlusal splints, the reader is referred to the discussion of Krouth-Poulsen.\(^2\(^3\)\)

**Prevention of Drifting**

The rationale for stabilization here is that drifting of teeth can lead to, or enhance the potential for the development of periodontal problems.

**Replacement of Missing Teeth.** Hirschfeld\(^2\(^8\)\) as long ago as 1937 warned of the consequences of the nonreplacement of missing teeth and berated dentists for not strongly advocating replacement of every tooth at the time of extraction. The classic case used as an illustration was the early loss of the mandibular first molar. Failure to replace it resulted in mesial drifting of the mandibular second and third molars, distal drifting of the mandibular premolars, extrusion of the maxillary first molar, marginal ridge discrepancies, open contacts, increased plaque retention, pocket formation, and development of occlusal interferences.

Others\(^5\) have also discussed this problem and advocated splinting as a solution.

A secondary benefit of this replacement is the prosthetic effect, or increase in function which results because the splint also acts as a prosthesis. Replacement of four missing first molars has been shown to result in a 50% increase in masticatory efficiency.\(^3\(^8\)\)\(^,\)\(^4\(^0\)\) The prosthetic effect also has been shown to become more important as more teeth are replaced.\(^3\(^8\)\)\(^,\)\(^3\(^9\)\)

**Postorthodontics.** Splinting postorthodontic tooth movement is used on a long or short term basis to retain teeth in their new positions.\(^4\(^1\)\)\(^,\)\(^4\(^2\)\) The rationale is to allow remodeling of the alveolar bone and rearrangement of the fibers of the periodontal ligament, thus stabilizing the tooth in its new position.\(^4\(^4\)\)\(^,\)\(^4\(^5\)\) This allows healing of an iatrogenically produced injury that is similar to the wound of pure primary trauma from occlusion. Only the origin of the force is different.

A complete review of the efficacy of splints (including retainers, night-guards, etc.) after orthodontic therapy is beyond the scope of this paper.

**Splinting the Diseased Periodontium**

As with the normal periodontium, the same basic categories exist, but in the presence, or aftermath of periodontal disease, new questions are raised:

- Can increased tooth mobility aggravate existing periodontal disease?
- Can tooth mobility initiate disease changes if other local factors are controlled?
- At what point is secondary trauma from occlusion present?
- At what point must mobility be considered abnormal?

**Prevention of Mobility**

**Splinting for Functional Reasons.** The rationale in this case is to splint where increased mobility makes function difficult or impossible.

Prichard\(^4\(^6\)\) advocated splinting of “loose teeth”, but also said it should be done only as a last resort and should be avoided if at all possible.

Stern\(^9\) and Clark\(^3\(^3\)\) stated that one of the rationales for stabilization is to decrease mobility and that one of its benefits was an increase in function for the patient. However, they did not say what they considered to be abnormal mobility and their reasoning was purely empirical.

Simring\(^5\(^2\)\) reported that temporary stabilization may be done to “increase the morale” of patients with multiple mobile teeth. One must assume this is due to an increase in function, but if this was his only reason for temporary splinting, it must be questioned in light of the problems associated with splinting.

Waerhaug\(^3\(^9\)\) concluded that, although a fixed partial
denture replacing missing teeth and including loose ones may increase function, mobile teeth can often function successfully for decades without splinting, provided proper periodontal therapy is provided. He looked at the patient’s function as well as the periodontal health before advocating splinting.

To Allow Repair During Periodontal Treatment. The rationale is that mobility may either cause or accelerate the progression of periodontal disease, or at the very least inhibit tissue repair.

Hirschfeld\textsuperscript{4} advocated the use of stabilization 1 to 2 years post-treatment in anterior teeth with residual mobility, to encourage the consolidation of supporting structures.

Friedman\textsuperscript{44} believed that unless splinted, mobile teeth may not respond as well to reattachment procedures.

Cross\textsuperscript{45} stated that in the absence of infection, mobility will inhibit repair and therefore splinting is indicated. Cross also advocated splinting in patients whose teeth remained mobile after treatment. He believed that immobilization of a loose tooth would often allow repair and subsequent tightening of the tooth so that the splint might later be removed.

Ward\textsuperscript{10} considered “pathologic movement” to be an etiologic factor in periodontal disease and advocated temporary splinting to prevent it.

With the acceptance over the last 20 years of the bacterial etiology of periodontal disease, Prichard\textsuperscript{48} and others\textsuperscript{18, 28, 56} have stated that mobility from occlusal traumatism does not cause periodontitis in the absence of local factors. This seems to be the consensus of most modern authors and therefore splinting to prevent periodontal disease does not appear to be justified.

Goldman\textsuperscript{16} and others\textsuperscript{48} have stated that the effect of trauma from occlusion on periodontitis is still unclear.

Many authors\textsuperscript{2, 4, 9, 12, 17, 51, 57, 73, 83} believe mobility as a result of trauma from occlusion will inhibit repair during local periodontal treatment and so they splint temporarily. Other authors\textsuperscript{60, 53, 44} including Prichard and Waerhaug believe differently.

Prichard\textsuperscript{51} rarely uses temporary splinting during periodontal treatment and when he does, it is not because he believes it improves healing.

Waerhaug\textsuperscript{29} reported that splinting and occlusal equilibration were begun in the days before the microbial etiology of periodontal diseases was established. Splinting then, as now, in the treatment of periodontal disease was based on clinical impressions with no hard data to show its efficacy. He believes splints may be substituted for real periodontal treatment and as such, may cause more problems than they cure. He has advocated a very conservative approach to splinting.

Despite the number of authors advocating temporary splinting,\textsuperscript{59-60, 62} the more recent studies tend to down play its importance. Its use seems to be based more on historic precedent than on documented efficacy.

Rateitschak\textsuperscript{79} followed 80 patients for 36 months after local periodontal treatment and found that scaling and treatment of local factors (selective grinding and oral hygiene) resulted in about a 20\% reduction of mobility, even though the values were still above what was considered normal. Some studies\textsuperscript{70-72} seem to point to a decrease in mobility with local treatment alone and mention no slowing of healing due to mobility. In fact, Gupta\textsuperscript{44} has reported that temporary splinting when combined with local periodontal treatment (selective grinding, oral hygiene instruction and scaling) tended to result in increased mobility when compared to local treatment alone. However, his clinical evaluation of mobility was subjective and the exact periodontal status of the patients was unclear.

Amsterdam\textsuperscript{49} and others\textsuperscript{66-68} have stated that splinting was also indicated following hemisection or root resection procedures to allow better healing. However, Klaavan\textsuperscript{69} in a recent clinical study of root amputated maxillary molars concluded that splinting after root amputation was unnecessary.

The general trend seems to be that unless final splinting is indicated, temporary splinting during periodontal treatment should be avoided. Mobility patterns should be correlated posttreatment to make a final decision as to their origin and need for treatment.

Prevention of Trauma from Occlusion

Although it is easy to classify trauma from occlusion as primary or secondary, it is much harder to determine clinically whether the mobility of a tooth is physiologic or whether primary or secondary trauma from occlusion is active.

Primary Trauma from Occlusion. If after periodontal treatment, mobility is still present, the cause should be explored. Most authors\textsuperscript{8, 18, 54, 28, 50, 56, 66} now agree that mobility will not initiate periodontal disease, so if primary trauma from occlusion is present, it should respond in the same manner as in teeth with a fully intact periodontium. (Refer to occlusal therapy above).

Secondary Trauma from Occlusion. Secondary trauma from occlusion is caused by physiologic forces exceeding the adaptive capacities of the periodontium. This results in an increase in tooth mobility. Secondary trauma from occlusion is sometimes referred to as pathologic mobility because damage is being done to the periodontal ligament. The problem arises in diagnosing secondary trauma from occlusion. All teeth exhibit some degree of mobility which may vary with a number of factors including the particular tooth, time of day and function of the tooth.\textsuperscript{13, 14, 84}

Amsterdam\textsuperscript{2} believed that with the possible exception of mandibular anteriors, any mobility visible to the eye was pathologic. This is his clinical feeling.

Kjønnerund\textsuperscript{19} and Prichard\textsuperscript{49} stated that a ‘dull percussion test’ was indicative of trauma from occlusion, but offered no evidence.

Splinting during or after periodontal treatment often has been advocated to control the effects of secondary trauma from occlusion or pathologic mobility.\textsuperscript{8, 20, 61}
Amsterdam20 and Prichard29 stated that bilateral fixed splinting should be avoided if possible, but was indicated in cases in which the remaining attachment apparatus was qualitatively and quantitatively inadequate to withstand even minimal forces.

Prichard44 used removable splints to control cases of secondary trauma from occlusion when all teeth were present and resorted to fixed splints only when teeth were missing.

**For Ease of Treatment**

Some authors51, 52, 73 have advocated splinting of teeth to make scaling and occlusal adjustment easier. In light of problems of oral hygiene, margination, and maintenance created by splints, this seems unwarranted unless it is indicated for another reason(s).

**Prevention of Drifting**

**Replacement of Missing Teeth.** This is basically the same as in the normal periodontium with increased function as a secondary benefit (see above).

**Postorthodontics.** Splints used as retainers after orthodontic therapy in the periodontal patient are advocated for the same reasons as in the normal patient. However, due to the loss of bony support, it is generally believed51, 46-49, 76 that they should be of a more permanent nature.

**DISCUSSION**

As with any review of the literature, half of the problem is interpretation and terminology. Each writer uses generally the same terms, but their meanings vary from author to author. This is particularly true of the subject of stabilization and its relationship to periodontal disease. Much of the confusion over whether to splint or not in the treatment of periodontal disease seems to be a matter of semantics.

Increased tooth mobility may result from occlusal forces, loss of bony support as in periodontal disease, or any of a number of other factors. Because of a lack of a clinical standard for mobility or agreement over what degree of mobility is physiologic, it is hard to determine when teeth are overly loose and must be stabilized. A standard for this may never exist because what may be normal for one patient or one tooth at one point in time may vary at a later date and time or for another patient or tooth. This is to be expected for any biologic phenomenon. Just because mobility may be visible to the eye does not necessarily mean it is abnormal; it must be evaluated in light of the health of the periodontium, the occlusion, functional considerations and other clinical data.

A second area of confusion when discussing periodontal disease and splinting is the relationship of occlusion, trauma from occlusion, and periodontitis. It is now generally conceded that trauma from occlusion will not cause periodontitis. However, the question as to the effect of trauma from occlusion on existing periodontitis is still unclear.18, 63, 77, 85, 87-91 Many authors believed the two processes were interrelated, but like many other clinical impressions it never has been proven. If primary or secondary trauma accelerate or enhance the potential for initiation of periodontitis, then control of this trauma through splinting or other means becomes important in treatment and maintenance of periodontal patients. If on the other hand, the two processes are unrelated, and the changes of trauma from occlusion are reversible in the face of periodontitis, as they are in its absence, then splinting in the treatment of periodontal patients would not be indicated to control the periodontitis, but rather to restore function to a tooth (or teeth) where mobility or drifting from trauma has made function difficult or impossible. Logically, two similar models for its study exist.

1. If the two processes are separate, one would expect orthodontic treatment (which produces the changes of trauma from occlusion) in the presence of inflammation to produce no more periodontal changes than inflammation alone. Cross48 and others47-49 have stated that teeth should not be moved in the presence of inflammation because irreversible periodontal damage might occur. This implies that the two processes may be interrelated, but the authors have offered no proof.

2. The other model would be to study the effect of trauma from occlusion on a long term basis in an animal susceptible to periodontal disease. Inflammation would be controlled on one side of the mouth and not on the other. The effects of inflammation could be compared to inflammation plus trauma from occlusion.

Lindhe87 recently has reported such a study in beagle dogs where a jiggling type of trauma from occlusion was produced through a combination of a deflective contact on a high crown and a spring which pulled the tooth back to its original position. He found that over 6 months the tooth with periodontitis and trauma from occlusion had more apical epithelial proliferation and angular bone defects than the contralateral control which exhibited a more horizontal bone loss and less loss of attachment.

Polson88, 89 has attempted to test Glickman's80-93 hypothesis that a traumematic lesion and periodontitis are “co-destructive factors”. Using monkeys as experimental models he produced traumatic injuries to the periodontal ligament both mechanically and thermally in areas of preexisting periodontitis. Three to 6 months later he evaluated these areas histologically and found no more destruction in these areas than in areas of periodontitis only. He concluded that angular bony defects may be related more to location of the etiologic agent than to a combination of co-destructive factors. The similarity of these acute thermal and mechanical injuries to that produced by trauma from occlusion is open to question.

Another stumbling block is the term “pathologic mobility” which is often used interchangeably with the term secondary trauma from occlusion. It has been generally agreed that mobility, in the absence of local factors, will not lead to periodontitis. Increased mobility
is a consequence of periodontal disease or occlusal forces and as such is not pathologic (i.e., it does not initiate disease changes). Clinically, mobility might be better thought of as either reversible or irreversible. Reversible mobility is that mobility secondary to an abnormal force or inflammation, the removal of which results in elimination or reduction of the mobility. Irreversible mobility is that mobility secondary to a reduction in periodontal support and cannot be resolved short of splinting. Irreversible mobility is not necessarily detrimental to the periodontal health of a tooth. Many mobilities are a combination of these two types rather than purely one or the other.

A better rationale for splinting in periodontal treatment is that secondary trauma from occlusion results in a lack of “functional stability”. That is, clinically if gingiva is or can be made perfectly healthy, but if normal occlusal forces result in mobility, making function difficult or impossible; then splinting of some sort is indicated for functional purposes, not to prevent pathology.

Nyman has demonstrated that even in patients with severely reduced periodontal support and many missing teeth, fixed splints may be used to restore function to a dentition provided proper periodontal treatment is rendered first. He emphasized proper occlusal relationships. One patient shown had been followed for three years and had five teeth cantilevered (in a row) with abutments on only one side of the arch.

At this point in time, the diagnosis of trauma from occlusion in periodontal cases is based on clinical judgement. One point should be kept in mind, however; just because a tooth is splinted, does not mean it is immune to trauma from occlusion. Glickman, Stein and Smulow have shown that excessive forces on one tooth in a splint caused comparable damage to all teeth in the splint. A splint increases the effective periodontal ligament area of each tooth in it and as such traumatic forces on one tooth may become physiologic when spread over several teeth. To be complete, a short discussion of the objections raised to splinting is in order.

One of the earliest objections to splinting was that of Chayes who felt rigid splinting restricted the circulation in the periapical areas of the splinted teeth. He offered no proof of this and many authors have decried this, pointing out that vertical movement was still possible and the only restriction was to movements in a horizontal plane. The excellent long term followup of cases treated with fixed splints by Amsterdam refutes this objection thoroughly.

A second objection was that the splint may cause more problems than it solves. Restorative margins have been shown to enhance the potential for gingival inflammation and oral hygiene is made much harder by fixed splints, so the expected advantages of a splint must be carefully weighed against the known disadvantages.

A third objection was that splinting is often abused. If used on patients for whom they are not indicated (especially fixed splints) they may lead to other problems such as those mentioned above. Several authors believed fixed splinting should be avoided whenever possible.

Finally, the lack of research into the clinical efficacy of splinting has been pointed out. Rationales for stabilization found to be valid are:

1. Prevention of mobility
   A. Post acute trauma.
   B. In occlusal therapy.

2. Prevention of drifting
   A. Replacement of missing teeth.
   B. Postorthodontics.

3. In treatment of secondary trauma from occlusion.
   A. For functional stability.
   B. With unknown effects on the progression of periodontitis.

4. The relationship of trauma from occlusion and periodontitis is unclear at this time.

REFERENCES

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**Abstracts**

**A Radiographic Method for Assessing Changes in Alveolar Bone Height Following Periodontal Therapy**

Rosling, B., Hollender, L., Nyman, S., and Olsson, G.


The method described showed that reproducible radiographs of several teeth can be taken with reliable accuracy using an oral device designed to direct the x-ray beams perpendicular to the alveolar process. The device consisted of an acrylic splint comprising the occlusal tooth surfaces, with five paired tracts placed on the buccal in a position to allow the fitting of vertically oriented films. A metal rod served as a connecting link between the splint and the core of the x-ray apparatus. The exposures were made at 60 kilovolt (peak) and 10 ma, and the distance from focus to object was standardized as well as processing of films. A stereocomparator system consisting of a cor-dinatograph and a mirror stereoscope with a micrometer were used to measure alterations in bone level. Two radiographs of the same tooth region obtained on different occasions were placed on examination to determine the reproducibility of the method. Using five patients with periodontal disease, treatment included a preparatory phase followed by periodontal surgery with bone denudation. Radiographs were taken 2 months after surgery and compared with control x-rays. Comparison revealed a mean decrease of interproximal alveolar bone height of 0.69 mm (S.E. 0.07). Alveolar bone loss was a constant finding in the pilot experiment which could be regarded as a reliable measure of bone loss. *Department of Periodontology, Faculty of Odontology, University of Goteborg, FACK, S-400 33, Goteborg 33, Sweden*

**Zinc Polyacrylate Cement as an Alloplastic Bone Implant**

Lawrence, L. G., Beagrie, G. S., and Smith, D. C.


To compare tissue reaction and healing of bone in response to an autogenous bone implant, plaster of Paris, and zinc polyacrylate cement, the materials were implanted in rabbit tibias and observed during a 16 week interval. Radiographs were made immediately postoperatively and at times of sacrifice which were at intervals of 1, 2, 4, 8 and 16 weeks. At that time tissue specimens were prepared for microscopic examination. Bone fill was complete by 8 weeks. The zinc polycrylate cement exhibited favorable tissue tolerance and acceptance. Normal healing was delayed by the implants when compared to the unfilled control defect. *Department of Prosthodontics, Faculty of Dentistry, University of Toronto, Toronto, Canada*

**Blood Flow Measurements in Skin Flaps**

Nathanson, S. E. and Jackson, R. T.


Fourteen mongrel dogs were anesthetized, their abdomens were shaved, and pedicle flaps were elevated with various length to width ratios. Quantitative measurements of their skin blood flow were made and compared using four radioactive microspheres. It was concluded that the cutaneous blood flow in ventrally based, abdominal skin flaps in dogs, is independent of base width as measured immediately after outlining and elevation. *Emory University School of Medicine, 441 Woodruff Memorial Building, Atlanta, Georgia 30322*