To splint or not to splint, that is the question

Introduction

Splints have been defined as follows:

- A splint is a device for supporting weakened tissues. It serves two purposes; it provides rest where wound healing is in progress and it permits function where tissues alone cannot perform adequately. (Manson & Eley, 1989).
- According to the *Journal of Periodontology* (Glossary of Terms, 1987) a splint is any apparatus, appliance or device employed to prevent motion or displacement of fractured or mobile parts. A dental splint is an appliance designed to immobilise and stabilise mobile (loose) teeth.
- A splint (Grant, Stern and Everett, 1963) is any device, which joins two or more teeth in order to provide support and reduce mobility. This would also apply to two or more teeth that have been repositioned orthodontically where a splint/retainer could be used to stabilise teeth and to reduce or prevent relapse.
- The term splinting in dentistry is defined as 'the joining of two or more teeth into a rigid unit by means of fixed or removable restorations or devices'. Siegel, Driscoll and Friedman (1999) go on to say that patients prefer splints that function similarly to the natural dentition and that are not removable.

In essence, the purpose of a splint to is stabilise support and improve function.

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Temporary splinting

The purpose of a temporary or provisional splint is to reduce the effect of occlusal forces for a limited period of time, and is important in these circumstances:

- Following accidental loosening of teeth after trauma
- As a supportive measure in the treatment of advanced periodontal disease
- For stabilisation of teeth during extensive occlusal reconstruction until restorative procedures are completed in other areas of the mouth, allowing for redistribution of functional occlusal forces
- For anchorage in orthodontic therapy (Ramfjord and Ash, 1971)
- Post-orthodontic retention.

Indications for splinting

The clinical rationale for splinting, or the indications, are described by Serio (1999) as follows:

- Control of forces of parafunction or bruxing.
- Stabilisation of mobile teeth for masticatory comfort.
- Stabilisation of mobile teeth during surgical, especially regenerative therapy. Temporary or provisional splints may be removable or fixed.
- Cross-arch stabilisation of an intact or virtually intact natural dentition.
- Stabilisation of a severely periodontally compromised tooth when more definitive treatment is not possible.
- Restoration of the vertical dimension of occlusion in a case of posterior bite collapse.
- Prevention of the eruption of an unopposed tooth.
- Post-orthodontic retention-a fixed or removable retainer is indicated.
- Redistribution of forces along the long axis of teeth.
- Stabilisation of loose teeth to restore the patient's psychological and physical well being.

The use of splints in dentistry

Maxillo-facial surgery

Splints are well known in the reduction, immobilization and stabilization of fractures, which may be closed or open reduction, either extra or intra-oral (See Fig 1). Splints are also used in orthognathic surgery as distinct from fractures.

In the mandible examples of splints are:

- dental wiring
- arch bars
- gunning-type splints
- transosseous wiring
- external pin fixation
- bone plating.

Fig. 1 is an example of a mandibular fracture splinted by a plate. The teeth have been ligated using dental wire. Wire ligation is also used to temporarily splint teeth that are periodontally involved and prior to permanent or prosthetic replacement. (Courtesy Dr J Kourie)

Prosthodontics

The Glossary of Prosthodontic Terms (Van Blarcom,1994) as quoted by Siegel *et al.* (1999) defines a splint as 'a rigid or flexible device that maintains in position a displaced or movable part; also used to keep in place and protect an injured part'. A secondary definition of a splint used in the same glossary is 'a rigid or flexible material used to protect, immobilise, or restrict motion in a part'.

The purpose of the splint is to gain occlusal stability. The principles are the same, but the techniques may differ.

Provisional splinting

Provisional splinting may be either full-coverage acrylic or reinforced composite resin splints with minimal tooth preparation. The reinforcement may be accomplished by eg. wire mesh, wire or polyethylene.

Indications for the all-acrylic splint according to Schluger et al. (1990) are:

- when periodontal surgery prior to splinting is not required
- when the treatment plan does not include orthodontic tooth movement
- when the interval between periodontal and/or endodontic therapy and the final restorations, is less than one year.

Permanent splinting

Permanent splinting may be either fixed or removable, and the fixed splints may be either resin bonded or cast metal. Examples of fixed (Figs 2a, 2b) and removable (Fig. 3) splints are shown.

Fig. 2a. The labial view of a fixed prosthodontic splint.

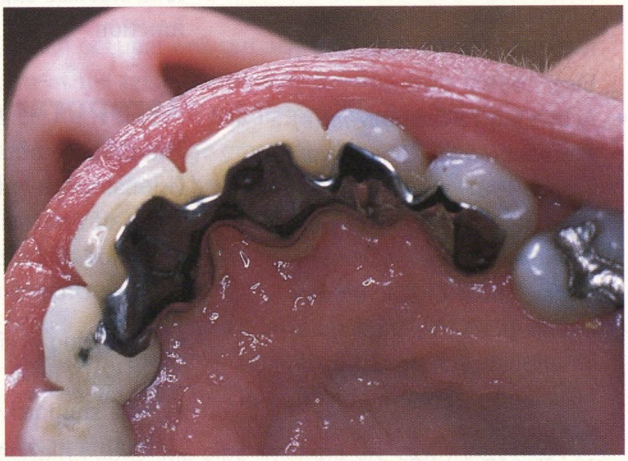

Fig. 2b. The palatal view of the same splint.

Fig. 3. A removable splint.

When to splint or when not to splint

If a patient is periodontally involved a permanent fixed cast restoration should be placed only after definitive periodontal therapy is complete.

Splinting is not indicated for the patient who is com-

fortable during normal mastication. Splinting with cast restorations is not indicated if stability cannot be obtained with a provisional acrylic bridge (Lindhe, 1983).

Periodontics

A periodontal splint, as defined by Carranza and Newman (1996), is an appliance for the immobilisation or stabilisation of injured or diseased parts. When periodontal disease is present there is both gingival attachment and alveolar bone loss. Tooth mobility and migration may follow, and with this an absence of stabilizing forces from the periodontal ligament, and this is a reason to splint.

Almost 100 years ago Matland and Matland (1902) wrote 'Fixation of the loosened teeth to each other, to sound ones, or to an apparatus fixed in the mouth, has often been tried, and with varying success. But is such treatment the best for the health and welfare of the patient? The chief function of the teeth is the masticatory one'.

Fifty years after Matland, Fish (1952) wrote in his book Paradontal Disease 'In advanced cases, therefore, some kind of splinting of the teeth seems to be inevitable. A paradontal (periodontal) splint is an appliance designed to mitigate the lateral stresses of mastication on individual teeth by affording them mutual support' (Fig. 4).

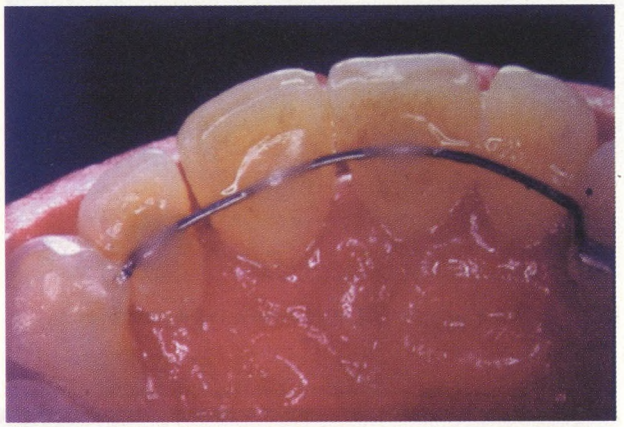

Fig. 4. A periodontal splint.

The objectives of splinting

Two main objectives of splinting in a patient with advanced periodontal disease are to create an oral environment in which firstly, tooth mobility is reduced or at least no longer increasing, and secondly, the patient is able to function comfortably. (Siegel *et al.*, 1999).

Should there be progressive mobility with increasing width of the periodontal ligament and loss of alveolar bone height, fixed cast restorations are indicated (Lindhe, 1983), provided there is no active periodontitis. Splinting should be done when mobility interferes with normal masticatory function.
Therefore, to splint, yes, but splinting alone does not make loose teeth firm.

When to splint

The removal of the causes is of prime importance. The inflammatory response around the attachment apparatus must be treated and controlled as part of the diagnosis and treatment of mobility (Pollack,1999). Carranza and Newman (1996) added 'permanent splinting should not be considered until all the inflammation around the teeth has been resolved'. This should be followed, where possible by tissue repair, surgical correction and or regeneration.

Fig. 5. An example of a permanent splint where extensive damage has occurred.

Orthodontics

The foregoing discussion dealt mainly with abnormal or pathological conditions where splinting played an important part in treatment or retention. However, splinting or retention is used in orthodontics principally as a post-treatment procedure to allow all adaptations of the hard and soft tissues to the new dental relationships and to reach a state of stability. Ficker (1998) wrote that once orthodontic appliances have been removed the teeth are exposed to a natural environment of muscular pressures, occlusal forces and physiological changes coincident with normal growth and/or ageing. This is a physiologic process, far removed from pathology, although the latter could also feature in a limited number of cases of treatment in adults who have periodontal problems, and there is a distinct link between retention and splinting (Carranza and Murphy, 1996).

Orthodontic splints/retainers: when to splint

Post-orthodontic retention: In general terms it may be said that the teeth are mobile at the conclusion of orthodontic treatment, and this is combined with a

concern for stability and the possibility of relapse. A stable orthodontic result is often dependent upon adequate retention that determines the question whether or not to splint.

Retention is thus aimed at maintaining newly established positions until the soft tissue has adapted and the periodontal tissues have reorganized. Riedel (1969) defined retention in relation to orthodontics as 'the holding of teeth in ideal aesthetic and functional positions'.

Consideration must be given to the details of retention at the time of diagnosis and treatment planning for a malocclusion, because retention depends upon what is achieved. The term splint or splinting in orthodontic terminology would be equivalent to retention.

The categories of orthodontic retention

In a comprehensive survey of retention, Riedel (1969) includes three categories depending on the type of treatment instituted:

* no retention
* limited retention
* permanent or semi permanent retention.

Examples where no retention is required would be corrected crossbites of one or more incisors with adequate overbite (Fig. 6a & 6b); dentitions that have been treated by serial extractions; and opening of spaces to allow for the eruption of previously blocked out teeth e.g. partially impacted mandibular second premolars.

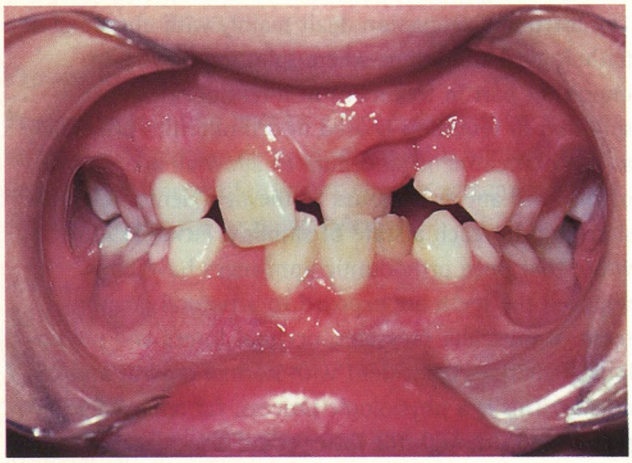

Fig. 6a. Teeth in occlusion showing one incisor in crossbite.

'Most typical orthodontic cases would fall into the category of limited retention. Many orthodontic corrections require time to allow muscular adaptation and sometimes to maintain the correction until growth has been completed.'

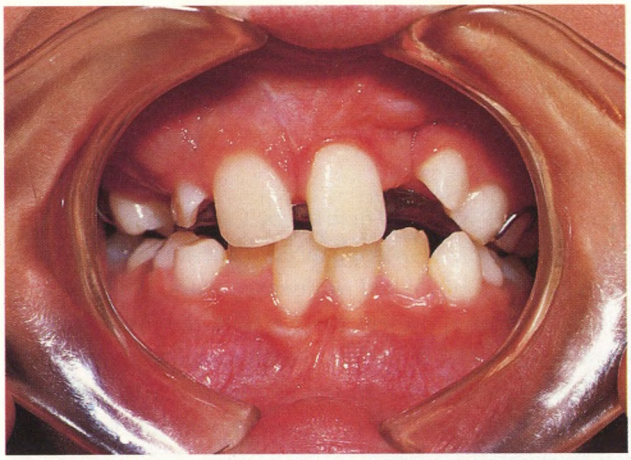

Fig. 6b. After treatment, showing tooth in correct occlusion.

Examples are Class 1 type 2 non-extraction cases where a Hawley type of retainer could be used (Figs 7a and 7b); also Class 1 and Class II extraction cases, when a bonded lower canine to canine lingual retainer is indicated in addition to the upper Hawley retainer. Deep overbite corrections are retained in the vertical plane by adding a bite plane to the removable Hawley appliance, palatal to the maxillary incisors.

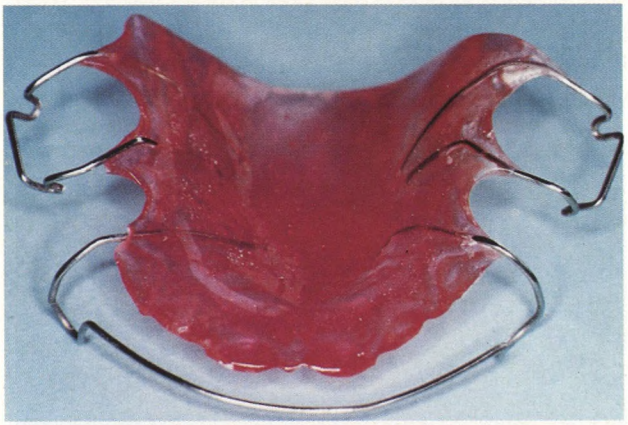

Fig. 7a. An example of a Hawley-type retainer.

***Fig. 7b. A Hawley-type retainer* in situ.**

In the last category of permanent retention are cases in which expansion has been the choice of treatment (especially in the mandibular arch), cases of generalised spacing, a wide upper midline diastema, and severe rotations. The latter two examples are of particular importance in adults. Useful options include placement of a Maryland type bridge (Fig. 8) or the more commonly used bonded stainless steel wire (Fig. 9). These examples have been confirmed by Josell (1999), and adapted from the work of Joondeph and Riedel (1994).

Fig. 8. A Maryland-type bridge bonded from canine to central incisor.

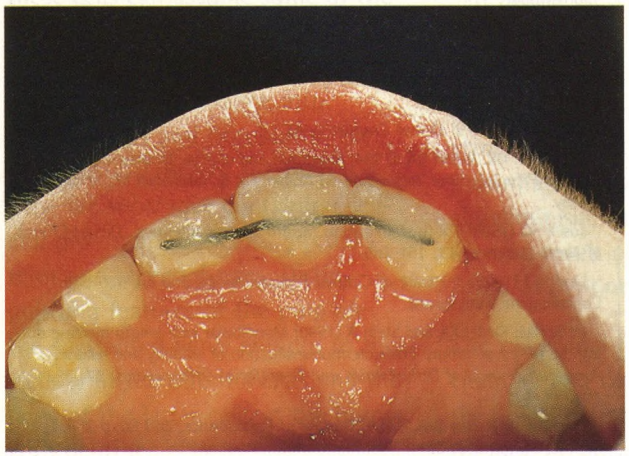

Fig. 9. A bonded stainless steel wire splint.

Becker (1987) and Dahl and Zachrisson (1991) found that Acid-Etch bonding a thin, flexible spiral wire lingually was an effective means of retaining realigned maxillary and mandibular anterior teeth (Fig. 10).

Types of orthodontic retention

The majority of orthodontically treated cases are retained by a maxillary Hawley type appliance (Fig. 7). In the lower arch the appliance of choice is a lingual stainless steel wire soldered to either lower cuspid or bicuspid bands, which are then cemented to these teeth (Fig. 11). The lingual arch may be extended as far back as the first permanent molars, depending on the original malocclusion and its treatment. A lower Hawley appliance may also be used.

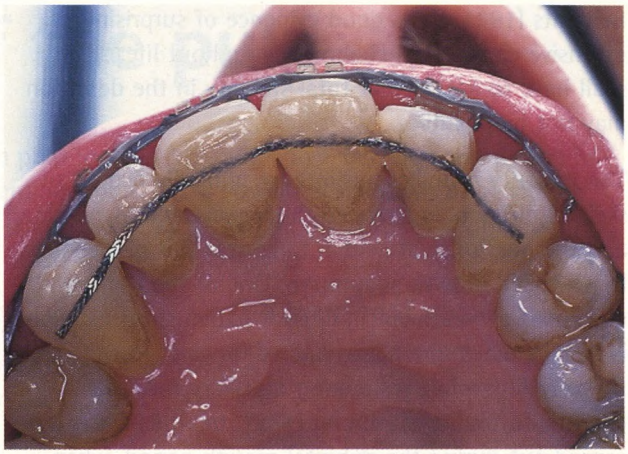

Fig. 10. A bonded stainless steel retainer.

Fig. 11. A lingual stainless steel wire bonded to either cuspid or bicuspid bands.

According to Carranza and Murphy (1996) some type of permanent retention is usually necessary after the desired tooth movement has been completed. Although many patients tolerate an extra-coronal retainer at night or even 24 hours a day, extra-coronal splinting or extra-coronal wire and composite splinting provide a reasonable alternative to indefinite removable appliance wear.

How long should retainers be worn?

The most important and controversial aspect of orthodontic retention is not the type of retainer to choose or use but the method and length of time that these retainers are to be worn.

In general there are no hard and fast rules and consensus among orthodontists may never be achieved. Retention appliances could be worn from 6 months to 2 years or until such time as maturation or cessation of growth has occurred, usually at 16 to 18 years, but retention may even continue into the early twenties.

Behrents (1985) finds good evidence of surprising extensive craniofacial changes throughout life, so we shall have to accept that total stability in the dentition may not be possible.

The majority of malocclusions are primarily related to skeletal differences between the maxilla and mandible, and the goal of treatment is to correct this discrepancy by so-called growth adaptation. One of the primary objectives of treatment in Class II patients, for example, is to take maximum advantage of forward growth of the mandible while restraining maxillary forward growth. To obtain maximum effect, treatment is often carried out during the pubertal growth period, when the intensity of growth is at its greatest. Whereas facial growth can be of great help during treatment of skeletal problems, it can also be the cause of instability of the treatment result. As growth in most orthodontic patients is not completed at the end of the growth spurt but continues for several years beyond the pubertal spurt, retention of the treatment result should also continue for a period of several years.

Many orthodontists instruct their patients to continue with retention with an upper removable retainer throughout life, combined with a bonded lower lingual retainer that should remain *in situ* for an indefinite period.

Little, Riedel and Stein (1990) state that the degree of post-retention anterior crowding is both unpredictable and variable. An alternative to long-term retention was described by Boese (1980), who demonstrated long-term stability of orthodontically rotated teeth using circumferential supracrestal fiberotomy (CSF) and reproximation with interdental stripping, precisely and conservatively performed.

A retention appliance named a Prefinisher and fitted immediately after debanding has been found by one of the authors to be an excellent method of retention. This appliance guides the teeth into "ideal" occlusal relationships while allowing soft tissue and periodontal adaptations to take place. After six months of successful wear, 2 hours daytime and at night, the daytime wear can be gradually reduced over the following 4 to 6 months. This is followed by night time use only, sufficient to maintain an excellent occlusion and healthy supporting tissues until the third permanent molars have erupted or been extracted. Indefinite wear may be necessary. The prefinisher may also serve as a mouth protector for contact sports.

The essence of the story is that post- orthodontic retention of a permanent or even semi-permanent nature is non-physiologic. Do we then agree that ageing changes are 'normal' and have to be accepted long term? In other words, perfect alignment throughout life is 'artificial' – therefore permanent retention may be considered as unacceptable.

As long ago as 1934 Oppenheim said that 'Retention is the most difficult problem in orthodontics, in fact it is **the** problem'. Even pre-dating this, Hawley (1919) wrote 'If anyone of them would take my cases when they are finished, retain them, and be responsible for their further progress, I would gladly give them half the fee'.

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