Abstract: The time at which orthodontic treatment should be started remains a matter of conjecture. Anomalies of dental development and functional problems tend to be addressed in the mixed dentition, while definitive treatment tends to be delayed until the late mixed dentition to maximize growth potential and patient compliance. However, some clinicians advocate starting treatment earlier in certain types of malocclusion. In this article, the current concepts of early treatment, both physiological and psychological, will be explored and the relevant indications and contraindications discussed.

Clinical Relevance: General dental practitioners need to have an understanding of the timing of orthodontic treatment in different types of malocclusion to maximize the effectiveness of patient referrals.

Within the practice environment, dentists are the first to examine and screen children for developing malocclusions. They are often faced with the dilemma of deciding at what age to refer for a further opinion and possibly treatment. This of course depends on the problem that has been diagnosed and the dental development of the child, but is there an ‘ideal’ time for orthodontic treatment, if the clinician wants to maximize the benefits of growth and cooperation without subjecting every child to four or more years of treatment?

Managing the Developing Dentition
From the eruption of the first primary tooth until the development and eruption of the wisdom teeth, the developing dentition should be monitored and interceptive treatment prescribed as necessary. There is a difference, however, between treatment decisions that are thrust upon us due to aberrations of dental development and types of malocclusion that we may choose to treat early by use of appliance therapy or elective extraction of teeth. Table 1 lists the problems that should be looked for at various stages of dental development.

It is obvious from these lists that the management of certain problems such as skeletal discrepancies or crowding can be undertaken at differing times during the dental development. When early treatment is contemplated, especially if it involves the use of active appliances, the following questions should be asked:

- Will early treatment correct the problem or eliminate the need for comprehensive treatment at a later date?
- Will the final result of two-phase treatment be better than that of a single course of treatment at a later stage?
- Will early treatment reduce the risk of trauma to susceptible incisors?
- Will early treatment result in greater skeletal change than treatment during the growth spurt?
- Will early treatment reduce the severity of the problem to make a second phase of treatment easier and of a shorter duration?
- Will early treatment create problems or reactions that are undesirable?
- Will early treatment have a beneficial psychological impact on the patient?

### Table 1. Problems to look for in the developing dentition in relation to timing of orthodontic treatment.

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<tr>
<th>Early mixed dentition:</th>
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<tr>
<td>Delayed eruption of permanent incisors</td>
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<td>Supplemental incisors</td>
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<td>Early loss of deciduous teeth</td>
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<td>Congenitally absent incisors</td>
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<td>One or more incisors in crossbite</td>
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<td>Impaction of first permanent molars</td>
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<td>Severe crowding</td>
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<td>Severe skeletal discrepancy</td>
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<td>Posterior crossbites</td>
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<tr>
<th>Late mixed dentition:</th>
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<tr>
<td>Severe skeletal problems</td>
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<tr>
<td>Unfavourably positioned canines or other teeth</td>
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<td>Congenitally absent permanent teeth</td>
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<td>Poor-quality first permanent molars</td>
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<td>Traumatic overbites</td>
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<th>Early permanent dentition:</th>
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<tr>
<td>Severe skeletal problems</td>
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<tr>
<td>Impacted teeth</td>
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<tr>
<td>Crowding</td>
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<td>Hypodontia</td>
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It is also important to differentiate between interceptive and definitive treatment: *interceptive* treatment is intervening in the developing dentition to allow it to achieve the best occlusion possible, or to make subsequent treatment as simple and short as possible. Therefore, although certain problems may be addressed earlier, there is a difference between a 6-month course of treatment in the mixed dentition followed by later treatment in the early permanent dentition and a definitive course of treatment that commences in the mixed dentition and extends over several years.

**EARLY MANAGEMENT OF TOOTH SIZE/ARCH SIZE DISCREPANCIES**

Historically, the enforced early loss of deciduous teeth (usually due to caries) often necessitated a decision whether to balance (to maintain the centre line) or compensate (to maintain the buccal relationship) with further extractions, especially when crowding was present. The advances in restorative techniques in paediatric dentistry and the more universal availability of comprehensive treatment with fixed appliances has meant these procedures tend to be carried out less and less. Conversely, current practice dictates that deciduous canines are often extracted early in the hope of correcting the palatal displacement of their permanent successors. A more elective choice is the early extraction of teeth for the relief of crowding. This can range from the removal of upper primary canines to create space for upper lateral incisors and stop them erupting into crossbite, to serial extraction. The latter procedure is rarely undertaken in its entirety now that comprehensive appliances are more readily available. Early extraction of premolar units in the late mixed dentition before eruption of the canines to allow alignment of the labial segments, however, remains a common practice.

The advantages of this are that it allows for spontaneous alignment of labiobuccal displacement of the incisors (especially in the lower arch), if the canines are mesially inclined. In the upper arch there is little or no spontaneous alignment of the incisors, but early loss of first premolars when the canines are unerupted, buccally displaced and short of space will allow for eruption of these teeth into the line of the arch. There is evidence that early extraction of first premolars, followed by active appliance therapy, results in less lower incisor irregularity than treatment with first premolar extractions and fixed appliances, once all the permanent teeth (except the second molars) have erupted.

If non-extraction treatment is planned and begins before loss of the second deciduous molars, in the lower arch the leeway space can be used for relief of crowding, as shown in Figures 1–3. If a lingual arch is placed during the mixed dentition only an arch length decrease of 0.44 mm has been reported, leaving an average of 4.44 mm leeway space. This allowed for the resolution of crowding in 60% of 107 patients with an average of 4.85 mm crowding at the start of treatment. It must be remembered,
however, that in patients in the primary dentition there is often a straight terminal plane at the distal aspect of the second deciduous molars. If there is spacing in the primary dentition as the permanent maxillary and mandibular first molars erupt, the space mesial to lower deciduous molars lets these teeth move forward, allowing the permanent molars to erupt into a Class I relationship. This is called an early mesial shift (Figure 4). However, if there is no spacing between the deciduous teeth (i.e. a closed primary dentition), there is no mesial movement of the mandibular deciduous molars as the permanent molars erupt, and they erupt into a cusp-to-cusp relationship. The mandibular leeway space therefore allows for mesial migration of the lower first molars into a Class I relationship as the deciduous molars are shed. This is called a late mesial shift (Figure 5). Therefore, if lower arch length is preserved to use the leeway space to relieve crowding, correction of the molar relationship will require distalization of the maxillary first molars, often using headgear.

Crowding is thought to be related to the dimension of the dental arches in that the greatest crowding exists in the narrower arches. This has led some clinicians to advocate active expansion of the arches in the mixed dentition in an attempt to create space to accommodate the complete dentition. Unfortunately, it appears that lower arch width, particularly in the intercanine region, typically decreases after treatment, regardless of whether a case was expanded during treatment or not. This results in higher degrees of relapse in cases where there has been enlargement of the mandibular arch.

**EARLY MANAGEMENT OF POSTERIOR CROSSBITES**

Crossbites with displacement are generally thought to be a functional indication for early orthodontic treatment. The aim is to stop the crossbite becoming established in the permanent dentition, as crossbites with displacement are one of the few occlusal traits that have a slight association with the development of temporomandibular joint dysfunction later in life. There is evidence of asymmetric muscle activity and altered bite force in children with a posterior crossbite with displacement.

Treatment in the primary or early mixed dentition by selective grinding and active expansion with a removable plate is thought to decrease the risk of the crossbite being perpetuated to the permanent dentition.
One factor that encourages early treatment is the fact that correction can often be achieved very simply with removable appliances and minimal patient compliance within a reasonably small time period. As such it is a procedure that can often be carried out in general practice. Although fixed expansion devices such as the quadhelix may result in orthopaedic as well as orthodontic expansion, there is evidence that removable appliances and quadhelices produce similar amounts of dental and skeletal expansion and have similar relapse rates, but that the use of removable appliances with midline expansion screws may result in less buccal tipping of the posterior teeth. Rapid maxillary expansion has been found to produce more bodily movement of teeth.

**EARLY MANAGEMENT OF CLASS III MALOCCLUSIONS**

The correction of anterior crossbites in the mixed dentition may prevent loss of periodontal attachment of the lower incisors. If only one or two incisors are in crossbite and there is adequate space available, a removable appliance can often be used (Figure 6): if space needs to be created and more bodily movement of teeth is required, better results may be achieved with simple fixed appliances (Figure 7). The success of either depends on creating a positive overbite at the end of treatment.

Both the above scenarios primarily relate to skeletal I or mild skeletal III relationships. Other methods of early correction of severe skeletal relationships have been described, including the use of functional appliances (Figures 8–10), protraction headgear, chin caps and headgear to the lower arch. All of these treatment modalities surprisingly seem to have similar clinical effects: proclination of the upper incisors, retroclination of the lower incisors and rotation of the mandible downwards and backwards. There also appears to be a slight anterior movement of the maxilla when protraction headgear is used, especially when accompanied by palatal expansion. The skeletal effects of protraction headgear also appear to be greater in pre-adolescent patients.

Early treatment of Class III malocclusions is generally not successful in cases with increased lower face height and minimal overbites. The overriding factor in whether treatment is successful is the underlying growth pattern, which tends to re-impose itself following treatment, especially mandibular prognathism.

**EARLY MANAGEMENT OF CLASS II MALOCCLUSIONS**

There is currently a resurgence in interest in the concept of two-phase treatment: early use of functional appliances in the mixed dentition, followed by a period of retention and then a second phase of treatment, usually involving the use of fixed appliances. The advocates of early treatment feel that starting early will maximize the chances of growth modification (especially in female patients who tend to reach their skeletal maturity earlier), allow for two chances to correct the malocclusion and avoid problems of compliance often encountered in adolescents.

It has been shown, however, that the skeletal contribution to correction of Class II division 1 malocclusions treated with twin blocks is greater if treatment is carried out during or slightly after the onset of the pubertal peak in growth velocity. Similar findings have been reported for the Bass appliance, the Herbst appliance and the FR-2 appliance. Further research has also shown that the early
use of functional appliances has little or no long-term benefit in terms of enhanced growth or better outcome over later one-stage treatment.27,28

So, if there are no advantages in early treatment physiologically, are there any psychological advantages? There is substantial evidence that the dental appearance has an effect on social perceptions and interaction,29 and can be a target of teasing.30 The negative impact of malocclusion on self-perception appears to increase with age.31 Despite this, early treatment for Class II malocclusion has been reported to have no effect on self-concept,32 although within this study the children looked at did not present for treatment with low self-concept in the first place. This is supported by other work which found that pre-adolescent children awaiting orthodontic treatment generally have higher than average self-concept.33 More recent work, however, may show that early treatment increases self-esteem (K. O’Brien, personal communication). Figures 11–13 show the case of a patient in the mixed dentition who requested treatment as a result of concerns about teasing at school.

One consistent finding is the increased incidence of trauma to the upper labial segment in pre-adolescent children with increased overjets.34,35 Increased overjet appears to be a greater contributor to traumatic injury in girls than boys, even though traumatic injury frequency is greater in boys.35,36 A high percentage of these injuries occur before the age of 10 years, especially in boys34 (probably due to the rougher nature of boys’ activities and their more active participation in sports).35

An advantage of starting functional appliance therapy in the late mixed or permanent dentition is that the functional phase of treatment can be followed almost immediately by the fixed appliances, which can incorporate mechanics designed to stabilize the newly established occlusion. By starting treatment in the mixed dentition, there will inevitably be a period when the clinician is awaiting further dental development before further treatment decisions can be made. This will mean either that treatment will have to be discontinued during this period or that some form of retention regime will have to be implemented. This may consist of wearing the appliances just at night, the use of headgear or the use of simple removable retainers. If the last policy is pursued, incorporation of an inclined anterior bite plane on an upper removable appliance will help to maintain the sagittal correction and allow the lateral open bites to improve as the dentition develops.37

**EARLY TREATMENT AND COMPLIANCE**

Another factor that has been used to favour early treatment is the greater compliance obtained from pre-adolescent patients. This has certainly been reported for adherence to instructions given for removable appliances38 and for headgear wear,39 although some studies have found no correlation between patient’s age and level of co-operation.30,40 Younger children are usually influenced by their parents and other adults but adolescents are more susceptible to peer pressure, especially in terms of self-image. Of course this can act in either direction when trying to encourage compliance to orthodontic treatment: if an adolescent has significant concerns about the appearance of his or her teeth and has
friends who are undergoing orthodontics, the treatment will have peer acceptance and compliance may be forthcoming; however, if no peers are undergoing treatment, orthodontic treatment may not be accepted.

Pre-adolescent children seem less concerned about peer approval and the ‘here and now’. This age group is generally aware of the reason for referral for orthodontic treatment, and understands the perceived benefits of treatment. There is therefore no indication that pre-adolescent children are not psychologically ready for treatment. One of the disadvantages of early treatment, however, is often the requirement for a second phase of treatment in the early permanent dentition. Whether the compliance during this second stage of treatment is affected by starting treatment in the mixed dentition is unknown.

**CONCLUSIONS**

- Expansion of the lower arch in mixed dentition to address crowding is inherently unstable.
- When correctly planned, early extraction of teeth for the relief of crowding may result in increased long-term stability – particularly in the lower labial segment – and simplify appliance mechanics during active treatment.
- Treatment in the mixed dentition is indicated for anterior and posterior crossbites with displacements on dental health grounds.
- If protraction headgear is planned for treatment of Class III malocclusions, treatment should commence in the mixed dentition for maximum benefit.
- Early treatment with functional appliances for Class II division 1 malocclusions does not appear to result in greater skeletal change than later treatment, and does not appear to offer any psychological benefits in the average child.
- Risk of trauma to the upper labial segment may justify early treatment of Class II division 1 malocclusions, especially in girls.
- Most orthodontic treatment can be started in the late mixed dentition just before loss of the primary mandibular second molar. This will maximize growth potential and compliance, allow for utilization of the leeway space and keep overall active treatment time as short as possible.

**REFERENCES**

2. Stephens CD. The use of natural spontaneous

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**Figure 11.** Class II division 1 malocclusion with lip incompetence and increased incisor show at rest.

**Figure 12.** Patient shown in Figure 11 during treatment with high pull headgear and Bass functional appliance.

**Figure 13.** Patient shown in Figure 11: end of active treatment (after 14 months).