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# The Orthodontic-Restorative Interface: 1. Patient Assessment

**Abstract:** The first article in this series of two aims to outline the assessment of patients for whom a combined orthodontic-restorative approach would be beneficial. In particular, it will concentrate on the assessment of patients who have hypodontia and tooth size discrepancies. The importance of the aesthetic assessment for these cases will be highlighted. Variations in tooth number and tooth size discrepancy often require a combined treatment planning approach from the orthodontist and restorative dentist. The referring general dental practitioner has a key role in recognizing that this approach may be required and highlighting this in the initial patient referral. It is likely in the more straightforward cases that the GDP will be providing the restorative treatment and so an increased understanding of these cases would be beneficial. In the second paper, treatment options will be presented.

**Clinical Relevance:** For patients who require a combined orthodontic/restorative approach, it is important that orthodontic and restorative disciplines liaise closely in the assessment and treatment planning process so that optimal care may be planned.

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In certain clinical situations functional and aesthetic requirements are such that resolution by one specialty alone may not provide the optimal result or may not even be possible. Consequently, an interdisciplinary approach to treatment planning is appropriate with close liaison of the orthodontist and restorative dentist. This allows the final functional and aesthetic aims to be determined prior to starting treatment.

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The knowledge of the orthodontic-restorative interface is important in the following situations:

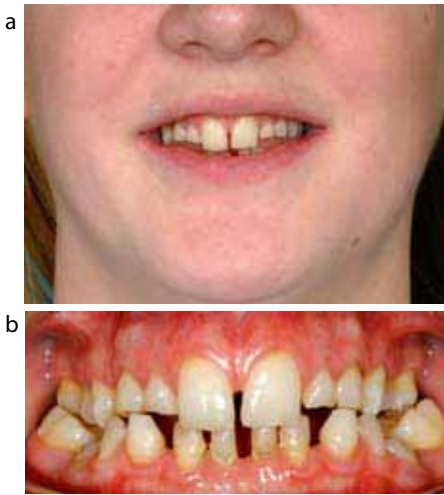
- Management of hypodontia;
- Tooth size discrepancies; and
- In the planning and treatment of cleft lip and palate (CLP).

The interface in the management of CLP, however, has possibly reduced with the use of alveolar bone grafting which allows the orthodontist to move teeth into the grafted cleft site successfully.<sup>1</sup> In order for treatment to be successful, the orthodontist needs to be fully aware of the intended restorative outcome and the restorative dentist must be aware of the possibilities that orthodontics can offer. The purpose of these two articles is to describe the assessment of patients and the clinical situations in which an interdisciplinary approach is appropriate. It is recognized that, frequently, this interdisciplinary team may also include paediatric dentists, oral surgeons, dental therapists and the patient's own general dental practitioner (GDP). The GDP has a key role, first in recognizing and referring the patient and then, in some cases, providing the restorative treatment following liaison with the interdisciplinary team.

Hypodontia is defined as the developmental absence of one or more teeth. The term oligodontia or severe hypodontia is used when six or more teeth are missing, excluding third molars.<sup>2</sup> The definition is not an indicator of the relative complexity of the patient's management; however, it is generally accepted that the management of the patient can be more difficult with an increase in the number of missing teeth.<sup>2</sup> The prevalence of hypodontia in the permanent dentition has been reported as being between 3.5% and 6.5%, excluding third molars.<sup>3</sup> It must be remembered that the relative frequency of the missing teeth does vary between ethnic groups.<sup>4</sup> The relative prevalence with which teeth are missing is as follows:

- Mandibular second premolars;
- Maxillary lateral incisors;
- Maxillary second premolars;
- Lower central incisors.

The management of hypodontia can be challenging and an interdisciplinary specialist approach to treatment planning and to providing the treatment is commonly taken. This team approach has been recommended as it offers many benefits to the patient and is designed so that he/she receives the best possible care.<sup>5,6</sup>



**Figure 1.** (a) Patient with hypodontia displaying retained deciduous teeth, spacing and an uneven smile. (b) Intra-oral view: note the gingival height levels, occlusal plane discrepancy, microdontia, and infra-occluded deciduous second molars.

- Peg laterals
- Spacing
- Malpositioned teeth (rotations, drifting)
- Microdontia
- Centreline shift
- Overeruption
- Uneven occlusal planes
- Over closed appearance
- Uneven gingival margins
- Hypoplastic enamel

**Table 1.** Aesthetic problems associated with hypodontia.

## Problems associated with hypodontia

### Aesthetic complaints

Hypodontia causes a combination of aesthetic and functional problems. Aesthetic concerns are the most common complaint and patients are generally unhappy with missing teeth, spacing, small retained teeth and an uneven smile<sup>6</sup> (Figures 1a and b). This can become more noticeable during adolescence, owing to exfoliation of the primary dentition, and can add to what may already be a stressful and demanding time. There is evidence that children and adolescents are frequently teased about their teeth and find this particularly upsetting.<sup>7</sup> Young patients with reduced dental aesthetics can experience more difficulties becoming accepted in social groups and there is a higher incidence of being bullied.<sup>8,9</sup> Research into the quality of life of patients shows that hypodontia has a negative effect on emotional and social well-being.<sup>10</sup> All these factors can lead to low self esteem which can continue into adulthood.<sup>11</sup> Taking this into consideration, improving aesthetics is a high priority for patients and the interdisciplinary teams. Table 1 has a list of aesthetic problems associated with hypodontia. In order to determine the full extent of the patient's complaint,

the specifics of the dissatisfaction must be explored, recorded and, where possible, addressed in the treatment aims. Care must be taken not to make assumptions about what concerns the patient, otherwise care could be directed towards a perceived problem rather than what actually concerns the patient. It must be remembered that dental professionals and lay people can have differing perspectives on dental aesthetics, with the latter being comparatively far less critical.<sup>12</sup> It must also be remembered that not all patients are unhappy with their appearance and they may seek treatment for alternative reasons.

### Functional complaints

A recent study found that the majority of patients that were referred for assessment to a hospital-based hypodontia clinic had a malocclusion which could be described as very severe or handicapping.<sup>13</sup> The severe malocclusion has the potential to cause a number of functional complaints, depending on the number of missing teeth. The potential complaints may relate to reduced masticatory efficiency and speech problems.<sup>6</sup> The functional concerns are, in some respects, secondary as the majority of patients have adapted so that primary functional complaints are uncommon.<sup>6</sup> Often, patients may have no functional concerns and this is why a thorough case assessment is required.

## Assessment

The process of assessing a

patient for an orthodontic and restorative interdisciplinary approach follows the normal structure of a dental assessment. In addition to the routine assessment, there are a few specific issues that must be noted during the process and these will be highlighted in subsequent sections. The following assessment can also be aided by clinical photographs and study models.

A thorough assessment of the patient is vital so that the correct diagnosis may be obtained and the optimal treatment plan defined. If the assessment is flawed then this can have a detrimental effect on the outcome of treatment for the patient. It is equally important to take into account the patient's concerns and expectations, as well as assessing his/her dental needs. The specific concerns of the patient must be, where possible, incorporated into the treatment plan. Perceived problems or aspects of care that may not meet expectations must be detailed at this time.

### Past dental history

The experience of the patient and his/her attitude to dental treatment is an important element to discuss. The treatment can often start in adolescence but can continue for a number of years until he/she is a young adult. An aversion to dental treatment must be taken into consideration when treatment planning as realistic options may be changed. It is also necessary to establish the patient's motivation and the standard of oral hygiene: a high level in both is desirable.

### Medical/family/social history

These parts of the history-taking process can highlight important issues that may have a bearing on the outcome. Medically, there are a number of conditions with which hypodontia is associated, the two most common being Down's syndrome and in association with cleft lip and palate.

Severe hypodontia can also be associated with ectodermal dysplasia syndrome. This is a group of more than 130 syndromes where there is an abnormality in at least one ectodermal structure.<sup>14</sup> The features of ectodermal dysplasia are classically described as a patient having sparse hair, eyebrows and eyelashes, frontal bossing, reduced sebaceous glands and dry skin. Intra-orally there may be a number



**Figure 2.** Tooth size discrepancy – peg-shaped lateral incisor.



**Figure 3.** Infra-occluded lower left deciduous second molar.



**Figure 4.** Extra-oral appearance of hypodontia patient with reduced occlusal vertical dimension.

is a familial link with hypodontia which can have implications for future generations. In addition, if parents have had previous experiences with the dental management of hypodontia, their attitudes to treatment may have a bearing and may need to be considered.

Smoking status is important to establish as this will increase the risk of oral disease in the long term. Any other habits, such as parafunction, nail-biting and contact sports should be noted.

### Clinical examination

#### Extra-oral examination

The skeletal relationship and any possible asymmetries present are assessed, as this could have a significant impact on the decision about whether the space associated with the missing teeth is either reopened for a prosthetic replacement or closed to help disguise the condition. Other important areas for assessment are the level of the lipline during smiling and at rest, the upper lip length and the anterior maxillary alveolar height, as these will affect the amount of incisal display. The assessment of the smile in relation to dental aesthetics will be considered later in the article.

#### Intra-oral examination

The periodontal examination should include an assessment of the gingival architecture; condition, shape and relative heights are important, as these may be visible during smiling. An objective assessment of plaque control is also noted. The quality and the amount of soft tissue in the edentulous spaces should also be taken into consideration.

The teeth present are assessed and the surface condition, shade, shape, position, mobility and relative size discrepancy noted (Figure 2). The condition of the teeth is particularly important in terms of caries experience, both past and present, and whether there are any surface defects or discoloration. Shade is less of a concern as vital bleaching can improve this relatively easily. Missing permanent or retained deciduous teeth are noted so that further investigations can be carried out. There is a risk that deciduous second molars may become ankylosed and infra-occluded (Figure 3).

The dimensions of the edentulous spaces should be assessed and compared to either the contra-lateral teeth (if present), the average width measurements or the space required for the restorative replacement. The morphology of the alveolar ridges should be considered as these are often poorly developed in patients with hypodontia. This is especially important if dental implants are to be considered and if any retained deciduous teeth are to be extracted for implant placement.

The static and dynamic occlusal relationships should be assessed as this is helpful from an orthodontic treatment planning point of view and also gives an indication of the potential forces that might be applied to any restorations or prosthesis. Commonly, there is a reduced occlusal vertical dimension, with the patient having an over closed appearance which would need to be addressed (Figure 4). There may also be reduced interocclusal space due to overeruption of unopposed permanent teeth.

#### Assessment of dental aesthetics

When assessing a patient with hypodontia it is important to make a thorough assessment of aesthetics. There are some general guidelines in this regard to aid in this subjective assessment. The dentist must bear in mind that there are no absolutes as to what makes an aesthetic smile and that all the proposed guidelines are open to debate. There are also differences in the perception between lay and professional opinion, as well as regional, ethnic and cultural differences. The

- Skeletal classification
- Symmetry (skeletal and dental)
- Lipline at rest and during smiling
- Teeth – number, size, position, morphology, shade
- Spacing – size, position
- Maxillary anterior occlusal plane
- Smile arc
- Buccal corridors
- Incisal display
- Mucogingival display
- Relative gingival margin heights

**Table 2.** A summary of the aesthetic assessment.

of dental anomalies including hypodontia, microdontia, hypoplastic enamel and xerostomia.

It is useful to establish if there



factors for determining dental aesthetics can be divided into facial, mucogingival and dental. A list of key features of an aesthetic assessment is given in Table 2.

## The ideal characteristics of the smile

### Facial factors

The facial factors include facial symmetry and coincidence of the facial and maxillary incisor centreline. Hypodontia can cause noticeable asymmetry and correcting or masking this forms a major part of any treatment plan. Symmetry about a midpoint is perceived in nature, art and in architecture as more pleasing and dentistry is no exception.

Lip level is an important facial factor in aesthetics as this controls the amount of incisal and gingival display at rest and during function. The most important function from an aesthetic point of view is smiling. During smiling the amount of incisal display and the relative position of the maxillary teeth are key factors. For a spontaneous smile the full length of central incisors with a minimal amount (1–2 mm) of gingival display is considered to be ideal. For youthful and female facial characteristics, a greater level of incisal display has been advocated, whereas for males and those with older facial characteristics less display is suggested.<sup>15</sup>

The smile arc is an imaginary line along the incisal edges of the maxillary teeth. It is determined by the position of the maxillary teeth relative to the lower lip and the arc should ideally follow a similar curvature to the lower lipline<sup>16</sup> (Figure 5). If there has been overeruption of unopposed teeth, this can cause the occlusal planes to be uneven, which adversely affects the smile arc. The underdevelopment of the alveolar process, which is associated with missing teeth, can also lead to occlusal cants, both anterior-posteriorly and transversely.

The buccal corridors are another key factor in assessing an aesthetic smile. The buccal corridors were originally described for denture construction and defined as the spaces between the facial surfaces of the posterior teeth and the corners of the mouth when smiling.<sup>16</sup> It is recommended

that patients do not have excessive buccal corridors but the exact size of the space is open to debate.<sup>17,18</sup>

### Mucogingival display

The amount of gingival display during smiling can vary greatly, depending on upper lip length, upper lip position, vertical position of the maxilla, as well as tooth number, spacing and position. For ideal aesthetics, 1–2 mm of gingival display above the central incisors has been suggested, with greater than 2 mm gingival display appearing to reduce dental attractiveness.<sup>19</sup> If there is a high smile lipline in a patient with missing anterior teeth, this makes restorative replacement more challenging. The transition from restorative prosthesis to gingivae can be a difficult area to address and soft tissue surgery, as well as bone augmentation, is frequently required.

The other important factors to consider are the relative heights of the gingival margins where bilateral symmetry and harmony are desired. The gingival margins of the central incisors and the canines should ideally be level with each other and the gingival margin of the lateral incisors should be slightly lower<sup>17</sup> (Figure 6).

In hypodontia cases the missing and spaced teeth also cause problems, with the loss of soft tissue architecture. Recreating this can be another challenging aspect, especially when treating severe hypodontia. The gingivae should portray a healthy appearance, where the morphology is well defined, scalloped, stippled, pink and with healthy papillae. Where a number of adjacent teeth are missing, recreating papillae around prosthetic replacements is difficult.

### Dental factors

The specific dental factors are numerous; the following is a brief overview. The aesthetic factors relating to the teeth are related to the number, size, position, surface condition, shade and morphology. Patients with hypodontia can have variations in all these factors.<sup>20</sup> Where possible, the aim is to produce a symmetrical arrangement of teeth that have a shade, size and morphology which are within normal limits. The space requirements in these cases are important



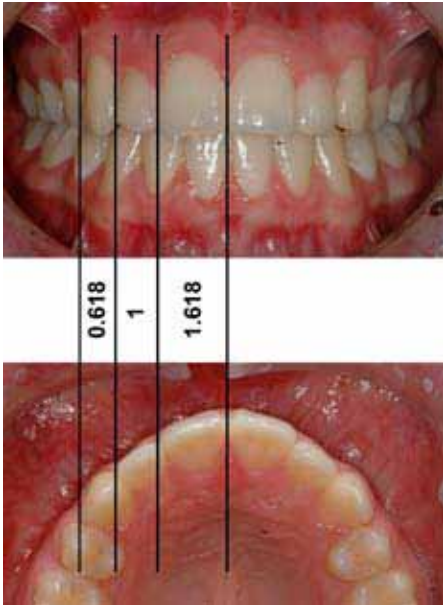
**Figure 5.** Smile arc – demonstrating the harmonious relationship between the incisal edges and the curvature of the lower lip.



**Figure 6.** A post orthodontic case demonstrating the ideal gingival heights, and the importance of symmetry about the midline in dental aesthetics.

considerations because space may need to be created or redistributed so that teeth can be replaced or reshaped. This means that the relative proportions of teeth have to be considered so that any prosthetic or restorative replacements are in harmony with the existing teeth.

Attempts have been made to provide a simple formula or ratio to aid the process of determining the relative tooth proportions. One such ratio is the 'golden proportion' (1:1.618) which has been suggested by some authors to be of use in dental aesthetics.<sup>21</sup> Lombardi<sup>22</sup> first discussed its application in dentistry but concluded that 'its use in nature was too strict'. The concept is that teeth, when viewed from an angle perpendicular to the maxillary centreline, should have a perceived relative width that relates to the golden proportion. Some authors have suggested its use to calculate the space requirements for missing teeth. However, this is not as straightforward as it first may appear because the concept uses the perceived width of the present tooth to calculate the perceived width of the missing tooth. For example, in the case of a missing lateral incisor, simply measuring the teeth intra-orally is not correct as the maxillary incisors are aligned on a curve rather than on a flat plane (Figure 7). The perceived width of the central would have

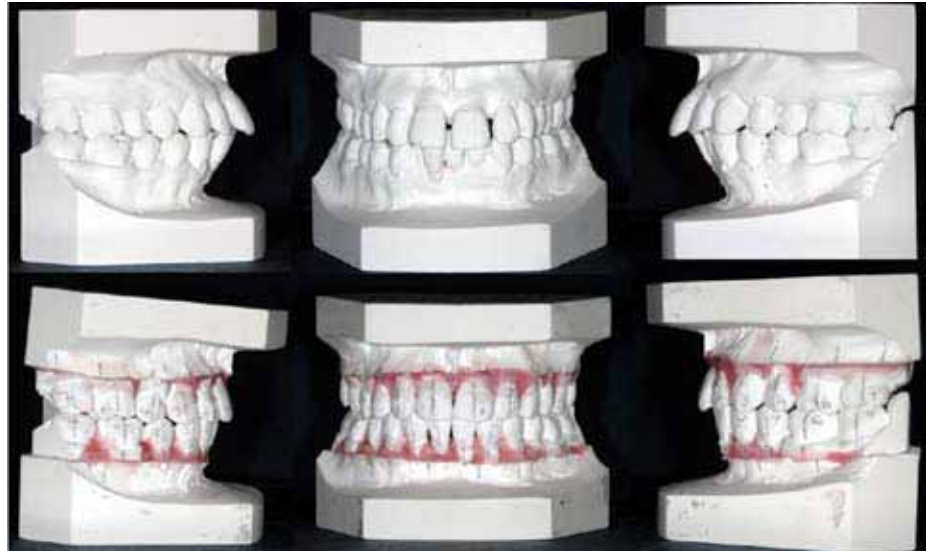


**Figure 7.** Golden proportion – the perceived widths of the central incisor, lateral incisor and canine as viewed from the front; this differs from the actual widths of the teeth owing to the fact that they are aligned on a curve as seen from above.

to be measured from a photograph with the ratio applied to calculate the desired width of the lateral. It has also been shown that the strict application of the ratio in the anterior maxilla causes progressively more narrow teeth and an arch form that is too narrow.<sup>23</sup> Research has failed to prove that the ratio commonly exists in the anterior maxillary teeth.<sup>24,25</sup> It is for these reasons that the application of the golden proportion is not recommended. It is advisable to treat the patient as an individual and make an assessment taking into account the patient's opinion and to recognize that there may be genetic, ethnic and cultural differences in deciding what is aesthetic. Bukhary *et al*<sup>26</sup> demonstrated that what is deemed to be the most aesthetic length and width for lateral incisors varied between individuals with hypodontia, those without hypodontia and dentists. For the case of missing teeth, a knowledge of the mean widths and mean width/length ratios may be more appropriate, as well as considering the space requirement for the intended restoration.<sup>23,27</sup>

### Diagnostic set up

The diagnostic set up can be



**Figure 8.** A Kesling set up series.

used to confirm the suitability of a particular treatment plan, to help decide between a number of possible treatment options and are of benefit to both clinicians and patients. They can take a number of forms such as:

- Traditional diagnostic wax up/Kesling set up;
- Chairside clinical build up;
- Visual set up.

### Diagnostic wax up/Kesling set up

This involves the repositioning of teeth once they have been cut off a set of study models, reshaping teeth by adding wax or removing stone, and also the replacement of any missing teeth (Figure 8). An additional benefit of including prosthetic teeth in the diagnostic wax up is that they can then be subsequently used during the orthodontic treatment to establish the corrected sized spaces. The cast should ideally be mounted on an articulator, having taken a facebow and inter-occlusal record. The advantage of this is that the dynamic occlusion can be replicated (to an extent) so that the potential forces on the final restorations can be taken into account. If only the static relationship is considered, then this can result in the final restorations having excessive forces applied when in lateral excursions.

### Chairside clinical build up

This is a quick and simple option to enable a patient to have a visual appreciation of the possible aesthetic outcome during initial treatment planning. It is performed intra-orally using either white orthodontic wax or composite placed on to the unetched tooth surface. This enables both the clinician and the patient to assess the possible visual results of any restorative treatment. This is especially useful for cases of anterior tooth size discrepancy or spacing. This information can be retained with the use of clinical photography and making an impression of the reshaped teeth. It is recommended to supplement this with a diagnostic wax up prior to commencing treatment.

### Visual set up

This method advocates a series of pictorial representations of the patient's mouth at rest, smiling and speaking, which will demonstrate the degree of tooth display and the relationship between the teeth, gingivae and lips.<sup>28</sup>

### Radiographs

Depending on the age and dental development of the patient, there are a number of radiographs that could be taken. In general terms they are used to assess for caries, bone levels, root

development, root angulations, unerupted teeth, position of the maxillary sinuses and for cephalometric analysis. If implants are planned then, at the appropriate stage, cross-sectional radiographs or computerized tomography (CT) may be undertaken, with a radiographic stent to assess more accurately the dimension of the alveolar ridge in the edentulous space.

### Diagnosis and treatment planning

Once a thorough assessment has been carried out, the diagnosis can be reached and the treatment plan can begin to be formulated. In the next article, treatment planning and the options available will be discussed.

### Conclusion

The first article has outlined the assessment of patients where a combined orthodontic and restorative approach is appropriate. In order for cases, such as those described, to have the optimal result, a close liaison between the orthodontist and restorative dentist is essential. This requires an interdisciplinary approach to assessment so that clearly defined aims are determined from the outset. Commonly, aesthetics are a main concern to the patient and a logical and patient-centred approach to assessing these are required.

The second article will outline treatment options that may be considered to manage variations in tooth shape and number using a combination of orthodontic and restorative approaches.

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