

New teeth from old: treatment options for retained primary teeth

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IN BRIEF

- Raises awareness of the incidence of retained deciduous teeth and common causes, particularly for GDPs.
- Outlines treatment options for such patients.
- Describes situations where retention of the deciduous tooth/teeth may be preferable.

Retention of primary teeth beyond their expected exfoliation date is encountered relatively frequently. Most commonly this is due to absence of the permanent successor. In this article patient assessment and the restorative treatment options are discussed with particular emphasis on retention of the primary tooth/teeth in the medium to long-term. The restorative techniques that may be used to improve aesthetics and function of retained primary teeth are illustrated. Consideration of this minimally invasive approach is commended in such cases.

Introduction

Primary teeth may be retained for a variety of reasons, the most common being developmental absence of the permanent successor. While agenesis of primary teeth is rare (0.1–0.9%),¹ absence of permanent teeth is encountered relatively frequently with a prevalence of 2.5–6.9%.² Variations between racial groups have been noted as has a female predilection – a female: male ratio of 1.37:1 reported.² Various terms have been used to classify the number of missing permanent teeth. The absence of 1–5 teeth (except third molars) is described as ‘hypodontia’ while severe hypodontia or oligodontia is the absence of six or more teeth. Anodontia describes the complete absence of permanent teeth.³

Even when the permanent tooth is present it may fail to erupt leaving the primary tooth *in situ*. This can be a consequence of crowding, ankylosis of the primary tooth or the presence of supernumeraries or other obstructions.³ Maxillary canines may become ectopic if the adjacent lateral incisor is diminutive or absent.⁴

Many of these problems can be overcome with orthodontic and/or surgical intervention, a discussion of which is beyond the scope of this article.

Agenesis of some permanent teeth is more common than others. Third molars excepted, mandibular second premolars are most frequently missing (2.9–3.2%), followed by maxillary lateral incisors (1.6–1.8%), maxillary second premolars (1.4–1.6%) and mandibular incisors (0.2–0.4%)² while the absence of other teeth is relatively rare. It should be noted when treatment planning that patients with one missing permanent tooth are likely (83%)² to have at least one other missing tooth however, the absence of six or more teeth (oligodontia) is rare (0.14%).²

The aetiology of dental agenesis has yet to be fully explained. There is undoubtedly a genetic component^{5,6} with an autosomal dominant pattern of inheritance, variable expression and incomplete penetrance.³ Certain syndromes such as ectodermal dysplasia are associated with developmental absence of large numbers of teeth⁷ and even anodontia.⁸ Environmental factors may also be implicated such as trauma, infection, irradiation and endocrine disorders.²

Assessment of retained primary teeth

Often the general dental practitioner will be first to encounter developmental

anomalies.⁹ It is essential that practitioners monitor the developing dentition and there should be a high index of suspicion if eruption of permanent tooth is more than one year later than expected, or has not commenced within six months of the emergence of the contra-lateral tooth. Particular attention should be paid to maxillary canines which should be palpable buccally by the age of ten in most cases.¹⁰ Should concerns arise, early referral to a multidisciplinary team, often including paediatric, restorative and orthodontic specialists, is advised.

Careful assessment is essential for all patients with retained primary teeth. Following consideration of general issues such as the patient’s health, motivation, expectations and oral health, a local assessment should be made. Clinically this should focus on the coronal shape, colour and structural integrity of the primary teeth. The gingival level of these teeth and their relationship to the occlusal plane should be noted as it is often coronal to that of the permanent teeth. Inter-occlusal space may be reduced if primary teeth have worn allowing over-eruption of opposing teeth (Fig. 1).

Conversely, the gingival and occlusal levels may be apically located and inter-occlusal space increased. This is commonly referred to as ‘infra-occlusion’ and is frequently caused by ankylosis. Ankylosis is fusion of the cementum to the alveolar bone thus preventing normal

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adaptive changes as facial growth carries the adjacent occlusal plane coronally. If this progresses, it may appear that the primary tooth is 'submerging' or later it may become completely 'submerged'. Another cause of infra-occlusion is tipping of adjacent permanent teeth resulting in impaction of the primary tooth. Infra-occlusion has been detected in 55% of retained mandibular second molars¹¹ though severe infra-occlusion, where the occlusal level is below the gingival margin of the adjacent teeth, is much less common affecting only 2.5-8.3% of retained primary molars.¹²

In patients with several missing teeth, there may be considerable derangement of the occlusal plane - reduced occlusal vertical dimension and inter-maxillary space are frequently observed (Fig. 2). The occlusion should therefore be carefully assessed particularly the vertical dimension, retruded contact position, intercuspal position and excursive contacts. In patients with more challenging occlusal schemes, articulated study casts are invaluable and trial tooth adjustment and/or diagnostic wax-up are often helpful. Additive procedures can be demonstrated to the patient by applying orthodontic wax, uncured composite or a temporary crown and bridge acrylic intra-orally. An aesthetic preview is often more helpful in agreeing the desired aesthetics than a wax-up on a model, although reductive procedures cannot be trialled in the same way. The structure of adjacent teeth that may serve as possible bridge abutments should be assessed clinically as should the alveolar bone volume. The alveolus often 'necks in' apical to retained primary teeth - a factor that can complicate implant placement.

Radiographic assessment should include the length and form of the remaining root structure, apical status, periodontal support and, if previous films are available, the rate of root resorption. Vertical bone height and inter-radicular space should be considered, particularly if implant replacement is a proposed. If extraction and replacement of the primary tooth with bridgework is contemplated, radiographic investigation should include any potential abutments. For patients in the mixed dentition or where several missing teeth are suspected, panoramic imaging is indicated as other permanent teeth may be absent or ectopic.

Prognosis of retained primary teeth

Among the most important considerations when managing patients with retained primary teeth is their prognosis. Several studies have shown mandibular and maxillary primary canines and second molars have a much better prognosis than incisors and first molars.^{13,14} Primary mandibular second molars have attracted most attention in the literature. Due to frequent absence of the permanent second premolar, they are commonly retained into adolescence and adulthood. Bjerklin,¹¹ in a longitudinal study, assessed the fate of retained lower second molars from the age of 11-12 into adulthood. Of 59 teeth in 41 subjects only seven were lost, none of which were after the age of 20. Infra-occlusion tended to progress very slowly and was absent in almost half the sample. Root resorption was described as slow and the authors concluded that if primary lower second molars are retained until the age of 20, their prognosis is good. Other studies have found similar results^{15,16} (see Fig. 3).

Concerns have been raised with regard to periodontal bone loss on the mesial aspect of permanent molars when the adjacent primary tooth is retained and infra-occluded. Kuroi¹⁷ studied this risk in 68 individuals with 119 infra-occluded primary molars and found only two cases of significant bone loss. These authors therefore concluded that there is minimal associated periodontal risk.

Treatment options for retained primary teeth

Retain - if the root and coronal structure are good, the tooth is functionally and aesthetically acceptable, and there is no compelling orthodontic need for extraction, a primary tooth may be retained intact. The benefit of this approach is that minimal maintenance will be required and the primary tooth is likely to preserve the bone and soft tissue architecture. If the primary tooth does fail however, there may be insufficient space for an adult sized prosthetic replacement. Conversely, as in the case of a retained primary second molar, the space may be excessive.

Retain and modify - Where root and crown structure are good but infra-occlusion has occurred or aesthetic improvement is required, the primary tooth may be retained and reshaped. Most simply, direct



Fig. 1 Worn primary teeth (62, 63) with loss of inter-occlusal space and low gingival level



Fig. 2 Oligodontia with irregular occlusal plane and reduced vertical dimension



Fig. 3 A 74-year-old with an asymptomatic lower left second primary molar. Had such a tooth been extracted and replaced in adolescence or early adulthood, the restoration would almost certainly have required replacement on more than one occasion over the ensuing five or six decades

composite may be added, with or without the guidance of a diagnostic wax-up and silicone index. While some have suggested poorer bond strengths of composite to primary enamel,¹⁸ the authors have not found this to be a problem clinically (see Figs 4a-g).

Indirect restorations such as composite, porcelain or gold onlays have been described.^{19,20} In previously un-restored teeth, all that is required is preparation of a chamfer finishing line and elimination the occlusal fissure pattern. If present, old restorations should be removed and replaced with composite resin. Small cavities may be incorporated within the preparation and restored with a combined inlay/onlay. Several case reports have advocated

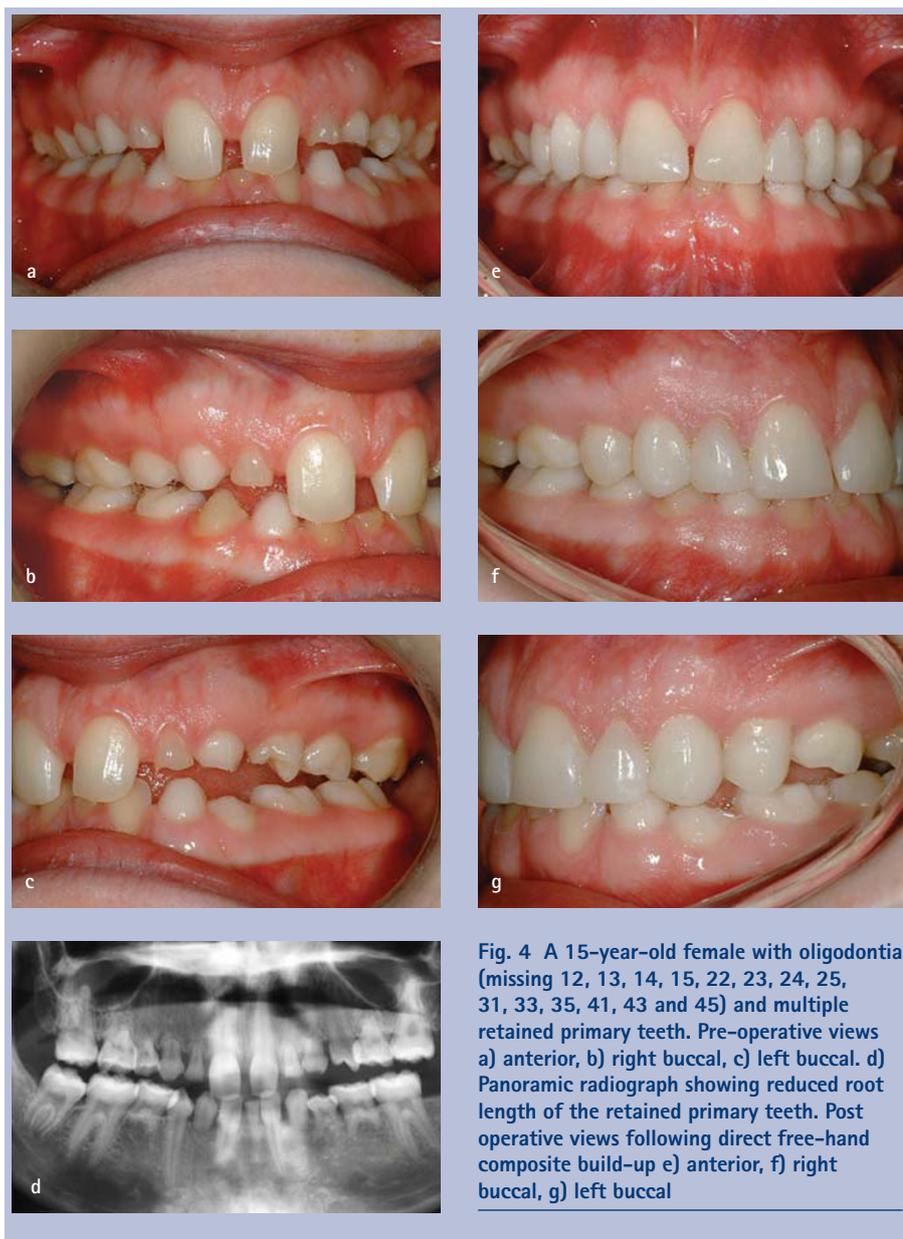


Fig. 4 A 15-year-old female with oligodontia (missing 12, 13, 14, 15, 22, 23, 24, 25, 31, 33, 35, 41, 43 and 45) and multiple retained primary teeth. Pre-operative views a) anterior, b) right buccal, c) left buccal. d) Panoramic radiograph showing reduced root length of the retained primary teeth. Post operative views following direct free-hand composite build-up e) anterior, f) right buccal, g) left buccal

onlays to restore infra-occluded primary molars thus preventing tipping of adjacent or supra eruption of opposing teeth¹⁹⁻²² (see Figs 5a-f).

Assuming infra-occlusion is not severe or progressive, there is the additional benefit that the hard and soft tissue architecture is preserved. It has been calculated for example that the alveolar ridge narrows by 25% in the four years following extraction of retained lower primary second molars.²³ Therefore, unless an extraction space is to be closed, early removal of primary teeth (without a permanent successor) may compromise future restorative management, particularly dental implants. It must be noted that some clinicians recommend early extraction where a primary molar is becoming severely infra-occluded as delay

may lead to the need for surgical removal later with associated bone loss.

It is currently uncertain what effect building up retained primary teeth has on their long-term survival. The crown:root ratio and occlusal loading may become less favourable and where significant build-up of molar teeth is necessary, the contact points with the adjacent teeth may be longer resulting in oral hygiene problems. Further research in this area is warranted.

Extraction and space closure – where crowding exists and an extraction is necessary in order to align the arch orthodontically, it is usually common to extract the retained primary teeth. In some situations, particularly where generalised spacing exists or in Class III malocclusions, space

closure may be difficult or undesirable. It may therefore be beneficial to retain a primary tooth with a favourable prognosis. It should also be noted that the second primary molar, the most commonly retained primary tooth, is wider mesio-distally than its permanent successor so complete space closure may be challenging.

Extraction and prosthetic replacement – if the arch is well aligned but the prognosis of the primary tooth is poor due to root resorption, caries, periodontal or periapical disease or inadequate aesthetics, extraction and prosthetic replacement may be necessary. Generally fixed replacement will be preferred unless there are a large number of missing teeth or the patient's cooperation is suspect. While conventional bridges may be considered, unless the potential abutments are already heavily restored, this is a relatively destructive option and may compromise pulpal health especially in younger patients. The restorations of choice tend therefore to be resin bonded bridges or dental implant supported crown or bridgework.

Resin bonded bridges have the advantage of relative simplicity, low cost and minimal morbidity. They are not directly dependent on bone volume in the edentulous site however aesthetics will undoubtedly be compromised if hard and soft tissues are deficient. Patients with developmental absence of permanent teeth may also have small teeth²⁴ and reduced enamel surface area available for bonding. Furthermore, in young patients gingival maturation may not be complete resulting in short clinical crowns. These problems can be ameliorated by localised gingivectomy to lengthen the crown of the abutment and extension of the retentive wing to cover most, if not all, the occlusal surface of posterior abutments. Resin retained bridges have limitations – there may be some shine through of the metal framework which can compromise aesthetics and the maximum span is generally two teeth. Some practitioners are reluctant to prescribe adhesive bridges due to concerns over their longevity. Pjetursson²⁵ however, in a systematic review, found the five and ten year survival of these restorations to be 87.7% and 65% respectively making them predictable restorations at least in the medium term.



Fig. 5 Retained and infra-occluded lower right primary second molar. a) Occlusal view, b) buccal view, c) radiograph showing favourable root length and form and absence of pathology. d) Chamfer preparation for composite onlay. Indirect composite onlay e) buccal view, f) occlusal view

Implants are recognised as the treatment of choice for replacement of missing teeth and generally have high success and survival rates.²⁶ Often however, where the permanent teeth have failed to develop, there is a corresponding underdevelopment of the alveolus.⁷ Reduced bone volume may complicate implant treatment necessitating local ridge augmentation, block onlay grafts, sinus grafting and in severe cases nerve trans-positioning or orthognathic surgery.²⁷ Clearly this increases the complexity, cost and morbidity of treatment and may compromise long term implant success. Patients in their teens or early twenties may be expected to live for another 60 years or more. It is highly likely that some complication will result in the need for replacement of implants over their lifetime. This, along with the likelihood that implant technology and augmentation

methods will continue to improve, means delaying implant placement in younger patients may be prudent. Furthermore, it is generally recommended that implant placement be delayed until skeletal growth has ceased. Retention of a primary tooth at least until the late teens is therefore desirable.

Primary teeth as abutments

The use of primary teeth as abutments for bridgework has not been widely reported in the dental literature.²⁸ If there is satisfactory root length, morphology and coronal structure, a conventional or resin retained bridge may be cantilevered from a retained primary tooth. If indeed there has been a degree of infra-occlusion this will reduce the need for occlusal preparation, though teeth with progressive infra-occlusion should not be selected. Where the primary tooth is

infra-occluded and a resin bonded restoration is chosen, the entire occlusal surface may be covered by the retaining wing or, in aesthetically critical regions, the buccal cusp may be recontoured with composite resin. When a conventional metal ceramic design is selected this problem will not arise however the preparation is more destructive. Pontic design should aim to place as little force on the abutment tooth as possible so an aesthetic pontic with minimal excursive contact is desirable.

Clearly the long-term prognosis of these restorations is uncertain, however, in some cases this may be the only viable fixed solution (see Figs 6a-j). Fusion of the roots of ankylosed teeth to the bone may make them relatively secure abutments, particularly if their root morphology is favourable. Cantilever designs are generally preferred to avoid the problems that may accompany partial debond or early failure of one abutment in a fixed:fixed design. Some clinicians may choose a fixed:fixed design where 'permanent' retention of orthodontically aligned abutments is desired though this is rarely the preference of the authors.

Discussion

There are undoubtedly indications for extraction of retained primary teeth. These include increasing mobility, clinical symptoms, pathology, unfavourable position and poor aesthetics. If primary teeth are lost however, complete orthodontic space closure may be challenging and each of the prosthodontic options has associated drawbacks.

Partial dentures may be the only viable option for some patients with large numbers of missing teeth and significant hard and soft tissue deficit. For patients with smaller numbers of missing permanent teeth it is usually preferable to avoid removable prostheses which are often poorly tolerated and may be associated with inadequate plaque control and associated oral health problems.

Fixed prosthodontic replacements too come with disadvantages. Conventional fixed bridgework is destructive and may compromise pulpal vitality, particularly in younger patients. Restoration margins may also become visible due to changes in gingival architecture. Resin bonded

bridgework, while less invasive, has limitations, as sufficient enamel surface area is required for bonding and they are limited to short spans. Implant placement, while appropriate in many cases, is invasive especially where bone augmentation is required and may not be appropriate for anxious or poorly motivated patients. Although their survival may approach 90% over ten years²⁶ there is little evidence relating to the survival of current implants or the associated coronal restorations over the patient's lifetime.

Patients with retained primary teeth should therefore be carefully assessed and all available treatment options considered. Given that the survival rate of some primary teeth may rival that of implants or other fixed restorations,^{15,16,26} serious consideration should be given to their retention, with or without modification. If such teeth are free from pathology and have favourable coronal and root structure, they may survive for many years and may even be considered as potential bridge abutments. Clinicians however should be aware of the risk of progressive infra-occlusion and careful monitoring of these teeth is essential.

The coronal form of primary teeth may be improved using a variety of relatively simple direct or indirect restorations. The techniques described come with little biological or financial cost and may delay or obviate the need for more invasive procedures. This approach to patients with retained primary teeth conforms to modern concepts of minimally invasive dentistry and should be considered in all such cases. As yet the prognosis of retained primary teeth and any associated restorations is unknown so further study to aid clinical decision-making in this area is warranted.

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Fig. 6 An 18-year-old male with oligodontia (missing 13, 14, 15, 23, 24, 25, 35 and 45) and retained maxillary primary second molars (55 and 65). Pre-operative views – a) anterior b) right buccal c) left buccal d) occlusal. Bone volume was insufficient for implants without grafting which the patient declined. There was reasonably favourable root morphology 55 and 65 and absence of other pathology e) panoramic radiograph. Composite build-up of the diminutive upper incisors, and the buccal cusps of the primary molars. Resin bonded bridges cantilevered from the retained primary molars with aesthetic pontics. Post operative views f) anterior, g) right buccal, h) left buccal, i) upper anterior, j) occlusal

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