Hypodontia

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Introduction

Hypodontia is defined as the absence of one or more primary or permanent teeth (excluding third molars) because of disturbances in the early stages of tooth development. Hypodontia, oligodontia and agenesis are the common terms used to describe the spectrum of absence of a single tooth to the rare absence of all teeth. The term anodontia has also been used in the literature to describe the absence of all teeth.

It is generally agreed that the absence of permanent third molars should be excluded when assessing the severity of the condition.

Authors have used the term mild to describe 1-2 missing teeth, moderate to describe 3-5 missing teeth and severe to describe six or more missing teeth (Nunn *et al.* 2003, John *et al.* 2013).

Other features that may co-exist with hypodontia include:

- Retrognathism
- Hypoplastic jaws
- Lack of alveolus
- Microdontia
- Conical crowns
- Transposition
- Hypoplasia of enamel

Prevalence

Primary dentition: Hypodontia is considered rare in the primary dentition with a prevalence range between 0.1-0.9%. Primary hypodontia is equally distributed between males and females with single missing teeth being the most prevalent type (54.9%). Primary maxillary lateral incisors are the most common missing teeth followed by the mandibular lateral incisors (Daugaard-Jensen *et al.* 1997).

Permanent dentition: Prevalence studies reveal a wide range of results between 0.3% and 36%. Polder *et al.* (2004) conducted a meta-analysis of approximately 127,000 participants using data from 33 publications; the study concluded that agenesis differs by continent and gender: the prevalence for both sexes was higher in Europe (males 4.6%; females 6.3%) and Australia (males 5.5%; females 7.6%) than for North American Caucasians (males 3.2%; females 4.6%).

The most common permanent tooth affected by hypodontia is the mandibular second premolar then followed by the maxillary lateral incisor and the third most commonly missing, the maxillary second premolar. The absence of one or two permanent teeth is the most common presentation (83%), with the absence of more than six permanent teeth being quite rare (0.14%) (Khalaf *et al.* 2014).

Aetiological & associated factors: Several theories have been proposed to explain the aetiology of hypodontia. They focus on either genetic or environmental factors. One of the original theories by Dahlberg (1945) applied Butler's Field Theory. According to this theory the jaw was divided into four morphological fields: incisors, canines, premolars and molars. The most mesial tooth in the field is considered genetically stable and so is rarely absent, and teeth at the distal end of each field are understood to be genetically unstable and more likely to be missing (Al-Ani *et al.* 2017). Moreover, Bolk's Theory of Terminal Reduction proposed that: "due to the evolutionary process in humans, the reduction of distal elements of tooth groups is more common than mesial elements" (Al-Ani *et al.* 2017). Together these theories could potentially explain the higher susceptibility to the absence of second premolars, lateral incisors and third molars (Gabris *et al.* 2006).

Inheritance pattern: Hypodontia was reported as being autosomal dominant with incomplete penetrance and variable expressivity. Moreover, anomalies in tooth size and number are sex-related and there is an association between tooth absence and microdontia. Thus, hypodontia and microdontia are more common in females, whereas males are more susceptible to supernumerary teeth and macrodontia. It was also confirmed that teeth number and size anomalies were more frequent in first-degree relatives than in the general population, and severe hypodontia was more likely to be passed on to relatives (Brook 2009).

Genetic factors: Dentition development is considered a complex process of epithelial mesenchymal interactions. The process involves signalling pathways and requires morphogens such as growth factors, transcription factors and receptors (Brook 2009).

Environmental factors: Craniofacial structures including teeth, originate from neural crest cells through specific cascades of developmental processes. Neural crest cells are highly sensitive to environmental factors that may increase the risk of craniofacial and dental anomalies (Al-Ani *et al.* 2017 & Meade and Dreyer 2023). Other environmental factors that influence hypodontia include increased maternal age, low birth weight, early exposure to certain infections, and some medications (Al-Ani *et al.* 2017). Treating malignancy using radiotherapy and chemotherapy in early infancy is strongly associated with the development of teeth anomalies including hypodontia (Nunn *et al.* 2003).

Associated syndromes and conditions

Hypodontia is often a feature of more generalised syndromes and systemic conditions. Examples include:

Down syndrome (DS): This syndrome is associated with craniofacial and dental anomalies including hypodontia, conical teeth, microdontia and retained teeth (de Moraes *et al.* 2007). Patients with DS had a high prevalence of permanent tooth hypodontia ranging between 54.6% and 58.5% with more severe patterns or with multiple missing teeth (Palaska & Antonarakis 2016).

Ectodermal dysplasia (ED): Defined as a group of inherited conditions resulting from a developmental defect in the embryonic ectodermal tissues including the teeth, skin, hair, sweat glands and nails.

Cleft lip and/or palate (CLP): CLP malformations due to abnormality in the embryonic development have complex multifactorial aetiology that includes both genetic and environmental factors (Murray 2002). Patients with CLP are more susceptible to dental abnormalities of both the primary and permanent dentitions (Ranta 1986, Tannure *et al.* 2012).

In an analysis of 240 panoramic radiographs of patients with complete bilateral CLP, hypodontia was present in 60% of the patients involving the lateral incisors and second premolars (Bartzela *et al.* 2010). Da Silva (2008) reported a high prevalence of hypodontia in complete bilateral cleft lip affecting the maxillary lateral incisors (26.6%), followed by the mandibular second premolars (8%) and the maxillary second premolar (4.6%).

Early Signs and Associated Dental Anomalies

Retained primary teeth: Primary teeth can be retained for significant time periods in cases of absent permanent successors, resulting from the delayed or prevented root resorption and exfoliation of primary teeth. This is advantageous in hypodontia cases because the longevity of the primary tooth acts positively in preserving bone, maintaining function and preventing possible supra-eruption of the opposing dentition (Haselden *et al.* 2001). However, infra-occlusion of retained deciduous teeth will reduce vertical alveolar bone development.

Diminutive teeth: The more severe the hypodontia the greater the possibility of having associated microdontia (Brook 1984). Diminutive maxillary lateral incisors usually appear tapered towards the incisal edge and are often described as “peg-shaped” lateral incisors (Lush *et al.* 2014).

Impaction/ectopic eruption of permanent canine: Ectopic eruption of the permanent tooth is a common feature in hypodontia cases, which is possibly due to a lack of space or lack of eruption guidance that is normally provided by the adjacent tooth. The maxillary canine is the most frequently displaced tooth. A study conducted by Brin *et al.* (1986) reported a high prevalence (43%) of palatally impacted canines associated with hypodontia or microdontia. More recently, Ancic-Millosevic (2009) reported an association between palatally impacted canines and the absence of second premolars in addition to peg-shaped and missing lateral incisors.

Multi-disciplinary Management of Hypodontia

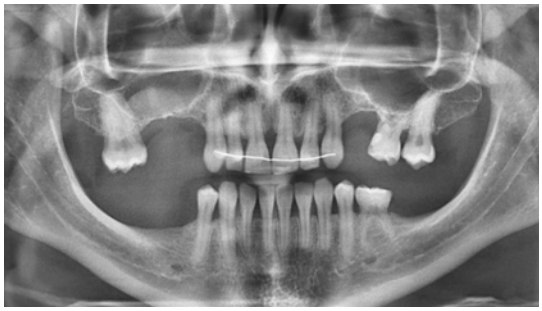
The treatment options available for the management of young hypodontia patients are essentially those available for the replacement of missing teeth in adults and will include removable partial dentures, conventional and adhesive bridgework and implant-supported prostheses. A succinct summary of prosthetic rehabilitation is provided here (Moore and McCord 2004) and here (Pace-Balzan *et al.* 2023)

Orthodontic Only Management

Spacing resulting from congenitally missing teeth can lead to tilting or rotation of the remaining dentition. Subsequent orthodontic intervention could be advantageous and is often necessary to allow good prosthodontic management (Carter *et al.* 2003).

Timing of orthodontic treatment: Ruiz-Mealin *et al.* (2012) conducted a study comparing radiographic teeth development in patients with and without hypodontia. They reported a generalised delay in dental development of approximately 1.5 years among hypodontia patients. This potential delay and elongation of comprehensive treatment must be relayed to patients from the onset.

Space management: Planning can be complex and each case requires individual consideration. Orthodontic space closure in mild cases is often considered a suitable management option principally as it can overcome the need for restorative treatment and the associated long-term burden of maintenance. For example, in cases of missing maxillary lateral incisor space closure, the canine can be moved mesially and the first premolar is moved to occupy the position of the canine if the canine has a reasonable crown morphology and emergence, however lateral guidance would need careful consideration. The canine often requires cosmetic reshaping to be disguised as a lateral incisor. A decision to opt for space closure requires careful consideration of the associated hard and soft tissue morphologies. Patients must be fully conversant and consenting to the resulting end-point. Kesling cast set-ups and manipulation of digital images may help in ensuring patient acceptance. Aesthetically, opening the space often gives the best result, albeit with an associated burden of maintenance, although in patients with high lip lines and wide smiles it may not always be possible for restorative replacements to meet aesthetic expectations.



Space opening or redistribution: This is often considered the best option when there is minimal or no crowding and in class 1 and class 3 cases, where space closure may worsen the malocclusion. This modality introduces the patient to definitive prostheses, which require lifelong maintenance (Carter *et al.* 2003). Both the restorative dentist, prosthodontist and the orthodontist must ensure optimal mesio-distal and vertical spacing, allowing for proper fit of the final prostheses (and/or the available root space for implant placement).

Comparative studies: space closure vs. space opening: A retrospective study was conducted to compare the outcome of the treatment options in cases of missing lateral incisors, space closure or space opening followed by prosthetic replacement. The aesthetic satisfaction of the patients was evaluated and the results revealed that patients treated with space closure were more satisfied with the aesthetic outcome than those who received a prosthesis (Robertsson S, Mohlin B 2000).

A summary video of the orthodontic-restorative interface is provided here:
https://www.bsspd.org/CPD%20Movie.aspx?prodid=557

Restorative Dentistry with or without Orthodontic Interventions

Although maintenance and utilisation of retained deciduous teeth is possible, consideration needs to be given to the longer-term prognosis of such teeth. Ankylosed or submerging (infraoccluded) teeth tend to have poorer long-term outcomes and are often better planned for their removal. The evidence base tends to lack robustness beyond the third decade of life despite case reports suggesting deciduous teeth can be retained and maintained (and cosmetically enhanced) for many years (Laverty *et al.* 2018). Such submerging teeth may be categorised as mild, moderate or

severely below the adjacent occlusal plane. In these instances the American Academy of Paediatric Dentistry recommends monitoring mildly infraoccluded primary molars when no adverse occlusal effects are present and recommends extraction when ankylosis leads to space loss or occlusal disturbance (AAPD 2022).

Restoration of spaces in hypodontia patients can be achieved using either adhesive or conventional bridgework, removable prostheses or dental implants. Many factors such as the patient's age, the number of missing teeth and the space distribution should be considered when planning restorative management. The patient's compliance and expectations should also be considered when making such decisions (Bishop *et al.* 2007).

Resin-bonded bridge (RBB): RBBs are a good choice for replacing congenitally missing teeth as they are not invasive. The most common failure mode of this prosthesis is debonding, but in this scenario the prosthesis can usually be recemented without any complications (Bishop *et al.* 2007 & Priest 2019). Many robust studies have reported a high survival rate for RBBs. Pjetursson *et al.* 2008 systematic review and meta-analysis investigated the 5-year survival and complications of RBBs and reported an estimated 5-year survival rate of 87.7%. A UK dental hospital study by King *et al.* (2015) looked at one thousand consecutive RBBs with 621 being reviewed resulting in a greater than 80% survival rate at 10 years. A more recent systematic review and meta-analysis by Thoma *et al. (*2017) included 2300 RBBs from 29 studies. The results indicated an estimated survival rate of 91.4% at 5 years and 82.9% at ten years. The most common complication was again identified as debonding (15%) followed by chipping of the veneering (4.1%).

Contemporary all-ceramic prostheses are gaining popularity and several studies have reviewed their effectiveness. Shahdad *et al.* (2018) reviewed 58 zirconia-ceramic RBBs with 48 restorations remaining in service with a survival rate of 82.7% over 3 years. Kern *et al.* (2025) reviewed 310 cantilever zirconia RRBs in 241 patients followed for a mean of 85, the 15-year retention rate of 82%. Garnett *et al. (*2006) study was specific to a hypodontia cohort and evaluated the performance of 73 RBBs used in 45 patients missing lateral incisors. Although only 24 patients attended the review, the 5-year survival rate was 55% for zirconia restorations.

Conventional bridges: The conventional bridge could be a reasonable treatment option to replace missing teeth when the abutment teeth are extensively restored rendering the RRB a poor choice (always giving consideration to the risk to pulp vitality). Hypodontia cases usually present with tooth shape and size discrepancies, a further advantage of the conventional bridge is that it is possible to alter the shape, size and shade of the adjacent abutment teeth at the same time as replacing those missing (Bishop *et al.* 2007). Often the teeth requiring conventional bridge preparations will be microdont (or conical) in their nature requiring a minimal marginal preparation when utilising contemporary ceramic materials.

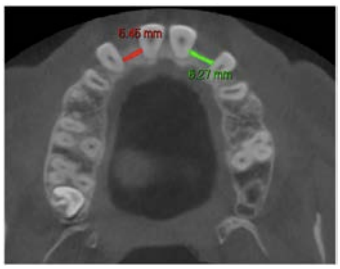
Removable dentures: Removable dentures can be used as an interim or definitive treatment option for hypodontia patients. These prostheses offer benefits in terms of being less invasive than implant therapy and better at conserving tooth structure than conventional bridges. In addition to providing rapid replacement of tooth structure, they can also provide soft and hard tissue replacement without complex grafting procedures. They may also be used in younger patients to adjust and maintain the occlusal vertical dimension (OVD) until a more definitive treatment can be considered after growth completion (Sweeney *et al.* 2005).

Overdentures: An overdenture can be used in oligodontia with few teeth erupted in the mixed dentition stage. The primary teeth can be overlayed by the denture and extra retention can be gained by any permanent erupted teeth (Stephen & Cengiz 2003). Indications for overdentures include the following:

1) Patients with very few teeth.
2) Patients with small conical crowns or short roots because retention and crown root ratios lead to unfavourable outcomes for conventional bridges and partial dentures.
3) Patients with a small dental arch who also require improved lip support.
4) Patients with large spaces between the teeth that cannot be corrected orthodontically.

Implant Supported Prostheses: Implants are considered the gold standard for the replacement of single or multiple missing teeth. For hypodontia cases, implant supported prostheses may include single crowns, bridges or a removable overdenture depending on the available teeth and supporting tissues. Implant placement is complex in the vast majority of hypodontia cases because the absence of teeth is usually associated with a lack of alveolar bone in the region (Breeze *et al.* 2017). The following Royal College publication provides guidance on NHS dental implant provisions.

https://www.rcseng.ac.uk/-/media/files/rcs/fds/publications/implant-guidelines.pdf



Detailed planning is essential to evaluate the possibility of implant placement and the required adjunctive procedures. This may be achieved via articulated study casts (Durey *et al.* 2014) or using digital workflow processes based on Cone beam computed tomography imaging. Such investigations must provide guidance for the position of the implant and the quality and quantity of available bone (Xiang *et al.* 2024).

A review of dental implant usage in hypodontia patients is available here:
https://www.bsspd.org/CPD%20Movie.aspx?prodid=335
And here
https://www.bsspd.org/CPD%20Movie.aspx?prodid=714

Implant placement age: It has been widely reported in the literature that dental implants should be placed after facial skeletal growth completion. The anterior maxilla is usually associated with inferior and anterior movement during growth. Consequently, an implant placed before maxillary growth completion would be infra-occluded and palatally displaced. If anterior maxillary implants are required in young patients, for example those suffering severe hypodontia/anodontia, they should not be placed before the age of 10 years in order to avoid the growth-related complications mentioned previously (Bohner *et al.* 2019).

Unlike the maxilla, the mandible is primarily influenced by sagittal and rotational growth. However, although the mandible is less affected by transverse growth, which usually ceases before eruption of the permanent canines, bone growth anteriorly in the premolar region could displace the implant lingually. Rotational growth has more of an effect on the position of the implant in the mandible as it alters the relationship with the adjacent teeth by changing the angulation of the implant. Thus, early placement of an implant in the severe hypodontia anterior mandible is safer than the maxilla but should be primarily reserved for patients with severe hypodontia/anodontia (Bohner *et al.* 2019).

Bone characteristics associated with hypodontia: Alveolar bone formation is a natural response to the presence of teeth and PDL, while bone remodelling is a response to functional loading. Therefore, the absence of dentition usually leads to reduced development of the alveolar bone which is associated with insufficient bone for implant placement. This subsequently gives the characteristic appearance of a reduced facial height in edentulous patients. The alveolar ridge of hypodontia patients in edentate areas is also narrow labio-lingually, making the appearance of a fixed bridge unfavourable and implant placement more complicated because of the risk of bone perforation.

Implant site development: surgical bone graft augmentation: The lack of alveolar bone in hypodontia patients often creates difficulties for implant placement. Therefore, bone augmentation using graft materials is usually required to provide an optimal surgical envelope.

Implant supported prostheses design

Fixed prostheses: Fixed prostheses are the most stable and favourable option for restoring function and appearance. When most or all of the dentition is missing, long span implant-based fixed restorations made from metal substructures veneered with acrylic resin teeth and flanges may be used. However, the main limitation with this type of restoration is the possibility of acrylic resin deterioration, which will require the removal of the whole bridge for refurbishing. When sufficient space is available, multiple small implant-supported bridges constructed from metal alloys and ceramics could offer more reasonable design (Durey *et al.* 2014), with an advantage being retrievability for refurbishment when required. For the implant super-structure, either single crown or multiple unit bridges, contemporary zirconia materials with labial veneered ceramic are increasingly being used and evidence is emerging that fracture strength of zirconia frameworks are similar when compared to more traditional titanium and chrome alloys (Vahnström *et al.* 2022).

Removable prosthesis: Although the fixed implant supported prosthesis is the ideal option, it may not be achievable in cases of long edentulous spans and when there is significant bone and soft tissue deficiency, both of which are associated with severe hypodontia. Therefore, implants can be used to retain and stabilise a removable denture that would address the hard and soft tissue deficiency in addition to the congenitally missing teeth. The flanges can provide this without the need for extensive augmentation procedures (Durey *et al.* 2014). A variety of attachment systems is available to attach the implants to the denture including bar-clips, ball and socket, magnets and locators. It is important to evaluate the available space for the prostheses before planning for specific attachments because some of these, such as barclips and ball and socket, are bulky and require more space, especially vertically. However, bars reduce the risk of bone or fixture overloading by allowing splinting of the fixtures, thus distributing the occlusal forces between

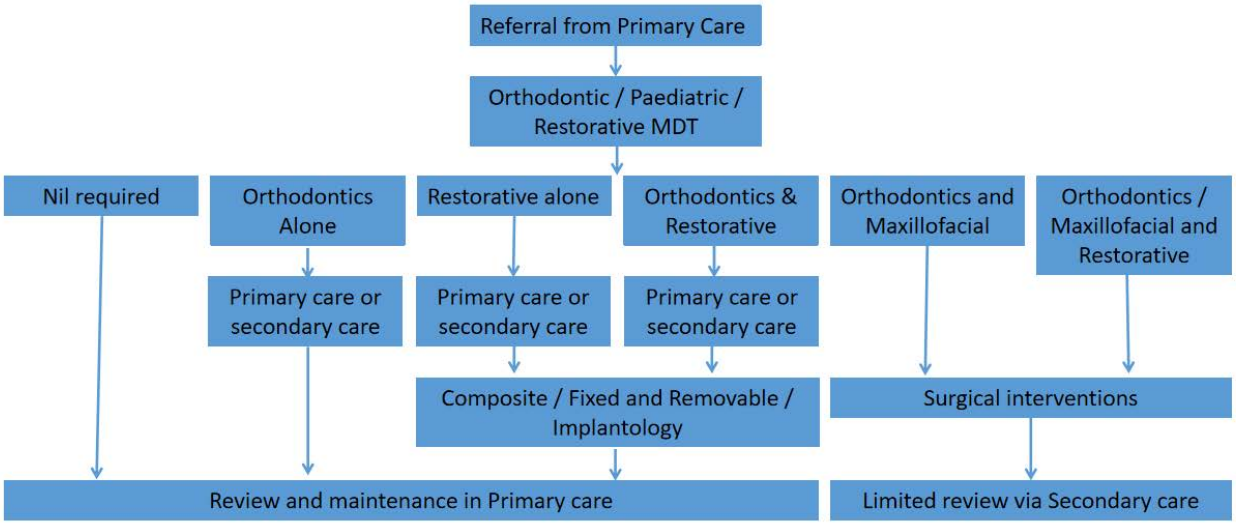
them (Guichet *et al.* 2002). They can also be made with distal cantilevers to which can be used to extend the dental arch.

Survival and outcome of implants in hypodontia: The long-term outcome of implants in general has been comprehensively evaluated with very high successes reported.

The survival of implants in hypodontia patients is an interesting topic that has been evaluated by a large number of authors due to common characteristics shared by patients. These include early age requirements of treatment and reduced quality and quantity of bone and keratinised gingiva at the implant site. A systematic review of the available studies reported that the best clinical outcome and patient satisfaction was achieved when implants were used to replace of congenitally missing teeth. The results revealed mean survival rates of 95.3% and 97.8% for implants and their prostheses respectively over a mean follow up of 4.3 years, with high levels of patient satisfaction reported (Terheyden & Wusthoff 2015).

Numerous studies have evaluated the factors that could influence the outcome of implants placed in patients with congenitally missing teeth. The age of the patient was found to have a significant effect on the outcome of the implants. Thus, a higher rate of implant failure was reported among children aged below 13 years, typically during the healing phase. In addition, slightly lower survival rates were reported when implants were placed in children under 18 years compared to adults. Other factors such as the severity of hypodontia, syndromic hypodontia, maxillary implants and implant-retaining fixed bridges and dentures had minor negative effects on the implant outcome (Terheyden & Wusthoff 2015).

A suggested referral pathway for hypodontia



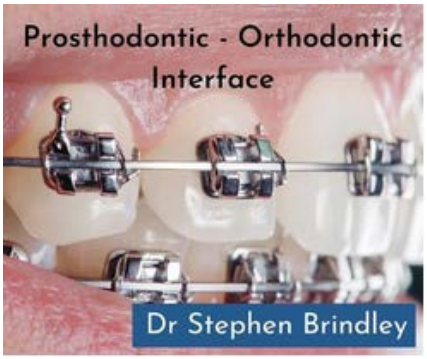
Initial referrals to secondary care services may be initially consulted with and referred to MDT clinics (Dougherty *et al.* 2023)

National guidelines for Hypodontia:

1. NHS England. Clinical standard for restorative dentistry. 2022. Available at: https://www.england.nhs.uk/wp-content/uploads/2022/10/B1640-clinical-standard-restorative-dentistry.pdf
(accessed October 2025).

2. Royal College of Surgeons of England. Guidance on the standards of care for NHS-funded dental implant treatment. 2019. Available at:
https://www.rcseng.ac.uk/-/media/files/rcs/fds/publications/implant-guidelines.pdf
(accessed October 2025

Links to BSSPD webinars on Hypodontia:



Prosthodontics-Orthodontic interface by Stephen Brindley
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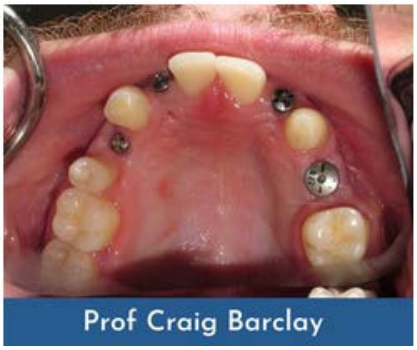

The role of implants in the management of hypodontia patients by Professor Craig Barclay

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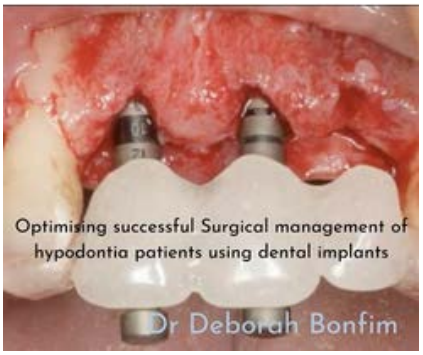

Optimising successful Pre- Peri- and Post-Surgical management of hypodontia patients using dental implants webinar by Deborah Bomfim

https://www.bsspd.org/CPD%20Movie.aspx?prodid=714

References

1. Al-Ani AH, Antoun JS, Thomson WM, Merriman TR, Farella M. Hypodontia: An Update on Its Etiology, Classification, and Clinical Management. B*iomed Res Int.* 2017;2017:9378325.
2. American Academy of Pediatric Dentistry (AAPD). Guideline on Management of the Developing Dentition and Occlusion in Pediatric Dentistry. Revision 2022.
3. Anic-Milosevic S, Varga S, Mestrovic S, Lapter-Varga M, Slaj M. Dental and occlusal features in patients with palatally displaced maxillary canines. *Eur J Orthod.* 2009 Aug;31(4):367-73.
4. Bartzela TN, Carels CE, Bronkhorst EM, Rønning E, Rizell S, Kuijpers-Jagtman AM. Tooth agenesis patterns in bilateral cleft lip and palate. *Eur J Oral Sci.* 2010 Feb;118(1):47-52.
5. Bishop K, Addy L, Knox J. Modern restorative management of patients with congenitally missing teeth: 3. Conventional restorative options and considerations. *Dent Update.* 2007 Jan-Feb;34(1):30-2, 34, 37-8.
6. Bohner L, Hanisch M, Kleinheinz J, Jung S. Dental implants in growing patients: a systematic review. *Br J Oral Maxillofac Surg.* 2019 Jun;57(5):397-406.
7. Breeze J, Dover MS, Williams RW. Contemporary surgical management of hypodontia. *Br J Oral Maxillofac Surg.* 2017 Jun;55(5):454-460.
8. Brin I, Becker A, Shalhav M. Position of the maxillary permanent canine in relation to anomalous or missing lateral incisors: a population study. *Eur J Orthod.* 1986 Feb;8(1):12-6. doi: 10.1093/ejo/8.1.12.
9. Brook AH, Griffin RC, Smith RN, Townsend GC, Kaur G, Davis GR, Fearne J. Tooth size patterns in patients with hypodontia and supernumerary teeth. *Arch Oral Biol.* 2009 Dec;54 Suppl 1:S63-70.
10. Carter NE, Gillgrass TJ, Hobson RS, Jepson N, Eechan JG, Nohl FS, Nunn JH. The interdisciplinary management of hypodontia: orthodontics. *Br Dent J.* 2003 Apr 12;194(7):361-6.
11. da Silva AP, Costa B, de Carvalho Carrara CF. Dental anomalies of number in the permanent dentition of patients with bilateral cleft lip: radiographic study. *Cleft Palate Craniofac J.* 2008 Sep;45(5):473-6.
12. Daugaard-Jensen J, Nodal M, Kjaer I. Pattern of agenesis in the primary dentition: a radiographic study of 193 cases. *Int J Paediatr Dent.* 1997 Mar;7(1):3-7.
13. de Moraes ME, de Moraes LC, Dotto GN, Dotto PP, dos Santos LR. Dental anomalies in patients with Down syndrome. *Braz Dent J.* 2007;18(4):346-50.
14. Doughty, F., Pillai, S., Hamill, D. et al. A service evaluation of the multidisciplinary team approach to hypodontia. *Br Dent J* 2023, 235, 514–519.
15. Durey K, Carter L, Chan M. The management of severe hypodontia. Part 2: bone augmentation and the provision of implant-supported prostheses. *BDJ* 2014, 216, 63.
16. Gábris K, Fábián G, Kaán M, Rózsa N, Tarján I. Prevalence of hypodontia and hyperdontia in paedodontic and orthodontic patients in Budapest. *Community Dent Health.* 2006 Jun;23(2):80-2.
17. Garnett MJ, Wassell RW, Jepson NJ, Nohl FS. Survival of resin-bonded bridgework provided for post-orthodontic hypodontia patients with missing maxillary lateral incisors. *British Dental Journal* 2006 201, 527-534.

18. Guichet DL, Yoshinobu D, Caputo AA. Effect of splinting and interproximal contact tightness on load transfer by implant restorations. *J Prosthet Dent.* 2002 May;87(5):528-35.
19. Haselden K, Hobkirk JA, Goodman JR, Jones SP, Hemmings KW. Root resorption in retained deciduous canine and molar teeth without permanent successors in patients with severe hypodontia. *Int J Paediatr Dent.* 2001 May;11(3):171-8.
20. John A. Hobkirk, Daljit S. Gill,Steven P. Jones, Kenneth W. Hemmings,G. Steven Bassi,Amanda L. O'Donnell,Jane R. Goodman. The Established Dentition with Hypodontia. Institute, Great University. 20 Sep 2013 (John Wiley & Sons, Ltd) - pp 150-187
21. Kern M, Türp L, Yazigi C. Long-term outcome of anterior cantilever zirconia ceramic resin-bonded fixed dental prostheses: Influence of the pontic location. *J Prosthet Dent.* 2025 Apr;133(4):1017-1023.
22. Khalaf K, Miskelly J, Voge E, Macfarlane TV. Prevalence of hypodontia and associated factors: a systematic review and meta-analysis. *J Orthod.* 2014 Dec;41(4):299-316.
23. King PA, Foster LV, Yates RJ, Newcombe RG, Garrett MJ. Survival characteristics of 771 resin-retained bridges provided at a UK dental teaching hospital. *Br Dent J.* 2015 Apr 10;218(7):423-8.
24. Laverty DP, Fairbrother K, Addison O. The Current Evidence on Retaining or Prosthodontically Replacing Retained Deciduous Teeth in the Adult Hypodontia Patient: A Systematic Review. *Eur J Prosthodont Restor Dent*. 2018 Mar 1;26(1):2-15.
25. Lush N, Holliday R, Chapple J, Nohl F, Cole B. Hypodontia: Aesthetics and functions part 1: aetiology and the problems. *Dental Update* 2014; 41:811-815.
26. Meade MJ, Dreyer CW. Tooth agenesis: An overview of diagnosis, aetiology and management. Jpn *Dent Sci Rev.* 2023 Dec;59:209-218.
27. Moore D, McCord JF. Prosthetic dentistry and the unilateral cleft lip and palate patient. The last 30 years. A review of the prosthodontic literature in respect of treatment options. *Eur J Prosthodont Restor Dent.* 2004 Jun;12(2):70-4.
28. Murray JC. Gene/environment causes of cleft lip and/or palate. *Clin Genet.* 2002 Apr;61(4):248-56.
29. Nunn JH, Carter NE, Gillgrass TJ, Hobson RS, Jepson NJ, Meechan JG, Nohl FS. The interdisciplinary management of hypodontia: background and role of paediatric dentistry. *Br Dent J.* 2003 Mar 8;194(5):245-51.
30. Pace-Balzan, A., Chatzipantelis, A., J. Dunn, K. *et al.* Restorative dentistry clinical decision-making for hypodontia: complex cases. *Br Dent J* 2023; 235, 489–495.
31. Palaska PK, Antonarakis GS. Prevalence and patterns of permanent tooth agenesis in individuals with Down syndrome: a meta-analysis. *Eur J Oral Sci.* 2016 Aug;124(4):317-28.
32. Pjetursson BE, Tan WC, Tan K, Brägger U, Zwahlen M, Lang NP. A systematic review of the survival and complication rates of resin-bonded bridges after an observation period of at least 5 years. *Clin Oral Implants Res*. 2008 Feb;19(2):131-41.
33. Polder BJ, Van't Hof MA, Van der Linden LP *et al.* A meta-analysis of the prevalence of dental agenesis of permanent teeth. *Community Dentistry and Oral Epidemiology* 2004; 32(3): 217–226.

34. Priest G. The treatment dilemma of missing maxillary lateral incisors-Part I: Canine substitution and resin-bonded fixed dental prostheses. *J Esthet Restor Dent.* 2019 Jul;31(4):311-318.
35. Ranta R. A review of tooth formation in children with cleft lip/palate. *Am J Orthod Dentofacial Orthop.* 1986 Jul;90(1):11-8.
36. Robertsson S, Mohlin B. The congenitally missing upper lateral incisor. A retrospective study of orthodontic space closure versus restorative treatment. *Eur J Orthod.* 2000 Dec;22(6):697-710.
37. Ruiz-Mealin EV, Parekh S, Jones SP, Moles DR, Gill DS. Radiographic study of delayed tooth development in patients with dental agenesis. *Am J Orthod Dentofacial Orthop.* 2012 Mar;141(3):307-314.
38. Shahdad S, Cattell MJ, Cano-Ruiz J, Gamble E, Gambôa A. Clinical Evaluation of All Ceramic Zirconia Framework Resin Bonded Bridges. *Eur J Prosthodont Restor Dent.* 2018 Nov 29;26(4):203-211.
39. Stephen A, Cengiz SB. The use of overdentures in the management of severe hypodontia associated with microdontia: a case report. *J Clin Pediatr Dent*. 2003 Spring;27(3):219-22.
40. Sweeney IP, Ferguson JW, Heggie AA, Lucas JO. Treatment outcomes for adolescent ectodermal dysplasia patients treated with dental implants. *Int J Paediatr Dent.* 2005 Jul;15(4):241-8.
41. Tannure PN, Oliveira CA, Maia LC, Vieira AR, Granjeiro JM, Costa Mde C. Prevalence of dental anomalies in nonsyndromic individuals with cleft lip and palate: a systematic review and meta-analysis. *Cleft Palate Craniofac J.* 2012 Mar;49(2):194-200.
42. Terheyden H, Wüsthoff F. Occlusal rehabilitation in patients with congenitally missing teeth-dental implants, conventional prosthetics, tooth autotransplants, and preservation of deciduous teeth-a systematic review. *Int J Implant Dent.* 2015 Dec;1(1):30.
43. Thoma DS, Sailer I, Ioannidis A, Zwahlen M, Makarov N, Pjetursson BE. A systematic review of the survival and complication rates of resin-bonded fixed dental prostheses after a mean observation period of at least 5 years. *Clin Oral Implants Res.* 2017 Nov;28(11):1421-1432.
44. Vahnström M, Johansson PH, Svanborg P, Stenport VF. Comparison of porcelain veneer fracture in implant-supported fixed full-arch prostheses with a framework of either titanium, cobalt-chromium, or zirconia: An in vitro study. *Clin Exp Dent Res.* 2022 Apr;8(2):544-551.
45. Xiang B, Yu J, Lu J, Yan Z. Comparisons between digital-guided and nondigital protocol in implant planning, placement, and restorations: a systematic review and meta-analysis of randomized controlled trials. *J Evid Based Dent Pract.* 2023 Dec;23(4):101919.