

A THERAPEUTIC APPROACH TO ORTHODONTIC SPACE OPENING IN THE UPPER LATERAL INCISORS HYPODONTIA. CLINICAL CASES

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Abstract

Aim. Dentists often encounter patients with missing or malformed teeth. The maxillary lateral incisor is the second most common congenitally absent tooth. We will present three therapeutic options for orthodontic space opening in three cases of congenitally missing maxillary lateral incisors.

Methods. Selecting the appropriate treatment option depends on malocclusion, specific space requirements, tooth-size relationship, and size and shape of the canine. These cases reports illustrate the need for a multidisciplinary team approach, not only at the treatment planning stage, but also throughout the entire course of treatment. The main objectives in the management of any hypodontia case are to improve esthetics and restore masticatory function. The appliance selected for space management depends upon the type of tooth movement required. In our cases, we decided to perform orthodontic space opening for future dental implants. The treatment methods we used were: sagittal expansion using the Distal-Jet appliance, the rapid maxillary expander with spider-screw (Leone, Italy) both followed by fixed orthodontic therapy, and in the third case, only the use of fixed orthodontic appliance.

Results. In cases of congenitally missing upper lateral incisors, the therapeutic methods for orthodontic space opening consisting in rapid maxillary expansion or sagittal expansion associated with fixed orthodontic appliance, allowed more rapid and efficient gain of necessary space in order to insert dental implants, compared to the orthodontic space opening using only fixed orthodontic appliance, especially in the case of generalized mesialisation due to absent lateral incisors, with the canines next to the central incisors.

Conclusions. Planning for space management is best carried out before initiating orthodontic treatment. The time of implantation should be close to the end of orthodontic treatment. As opposed to starting orthodontic space closure early, orthodontic space opening before implantation should be started late. Finally, the importance of interdisciplinary team treatment planning is emphasized as a requirement for achieving optimal final esthetics.

Keywords: congenitally missing lateral incisors; orthodontic space opening, hypodontia, treatment options.

O ABORDARE TERAPEUTICĂ A DESCHIDERII ORTODONTICE A SPAȚIULUI ÎN CAZUL HIPODONȚIEI DE INCISIV LATERAL SUPERIOR. CAZURI CLINICE

Rezumat

Obiective. Medicii dentiști se întâlnesc frecvent cu pacienți care prezintă dinți

malformați sau absenți. Incisivul lateral superior este al doilea cel mai frecvent dinte absent congenital. Vă vom prezenta trei opțiuni terapeutice de deschidere ortodontică a spațiului, în trei cazuri de anodonție a incisivului lateral superior.

Metode. Selecția celei mai adecvate opțiuni de tratament depinde de malocluzie, necesarul de spațiu, raportul dinți-spațiu, precum și dimensiunea și forma caninului. Aceste prezentări de caz arată necesitatea unei abordări multidisciplinare, atât în realizarea planului de tratament, cât și de-a lungul întregii etape de tratament. Obiectivele majore în managementul oricărui caz de hipodonție sunt îmbunătățirea aspectului estetic și restaurarea funcției masticatorii. Alegerea tipului de aparat pentru managementul spațiului se face în funcție de tipul de mișcare dentară necesară. În cazurile noastre am decis deschiderea spațiului pentru inserarea de implant dentare. Metodele de tratament folosite de noi au fost: expansiunea sagitală cu ajutorul aparatului Distal –Jet, expansiune maxilară rapidă utilizând expansorul cu șurub păianjen (Leone- Italia), ambele urmate de aparat ortodontic fix, iar în cazul al treilea s-a utilizat numai aparat ortodontic fix.

Rezultate. În cazul anodonției de incisiv lateral superior, metodele terapeutice pentru deschiderea ortodontică a spațiului, cuprinzând expansiune maxilară rapidă sau expansiune sagitală asociată cu aparat ortodontic fix, au permis obținerea mai rapidă și mai eficientă a spațiului necesar, în comparație cu deschiderea spațiului utilizând numai aparate fixe, în special în cazul mezializării generalizate datorată absenței incisivului lateral, caninul fiind lângă incisivul lateral.

Concluzii. Managementul spațiului este cel mai bine să se realizeze înainte de inițierea tratamentului ortodontic. Momentul implantării trebuie să fie cât mai apropiat de finalul tratamentului ortodontic. În final, este accentuată importanța abordării interdisciplinare a tratamentului, în scopul obținerii unei estetici faciale optime.

Cuvinte cheie: anodonție de incisiv lateral superior, deschidere ortodontică a spațiului, hipodonție, opțiuni de tratament.

Introduction

Disturbances during the early stages of tooth formation may result in the developmental or congenital absence of one or more teeth [26].

Hypodontia is the developmental absence of one or more teeth [1]. The etiology of hypodontia is unknown [9]. Several theories concerning the etiology have been proposed, including suggestions that both genetic and environmental factors may play a role.

Oligodontia is the term conventionally used in cases where 6 or more teeth are missing and anodontia, a much more rare finding, describes the developmental absence of all teeth [2].

The prevalence of hypodontia in the primary dentition is relatively uncommon, ranges are from 0.08% to 1.55% [1]. In the permanent dentition, prevalence has been reported to range from 2.3% to 11.3% depending on the population investigated [3-5]. It is most common in the anterior maxilla, the lateral incisors being most frequently affected (25%), followed by maxillary second premolars (20%) and the mandibular central incisors (6.5%)

[6,13,15].

Hypodontia of third molars has a prevalence of 9% to 37% [6]. Hypodontia in the primary dentition has no significant sex distribution, but in the permanent dentition females are affected more frequently than males by a ratio of 3:2.5 [15]. A strong correlation was found between missing primary teeth and their permanent successors: it was reported that about 60 to 100% of those who had missing primary teeth also had missing permanent successors [7,8].

Brook [10] suggests that most cases of hypodontia have a polygenetic inheritance pattern and that the risk of relatives having hypodontia will depend on a combination of numerous genetic and environmental factors. As well as the familial nature of hypodontia, it often presents as an isolated diagnosis with no detectable family history, which suggests it can occur as a result of a spontaneous genetic mutation. Hypodontia has also been associated with cleft lip and palate usually localized to the maxillary lateral incisor in the line of the alveolar cleft [14].

Several studies have shown that MSX1 and PAX9 genes play a role in early teeth development. PAX 9 is a paired domain transcription factor that plays a critical role in odontogenesis. All identified mutations of PAX 9 and MX1 have been associated with nonsyndromic form

Articol intrat la redacție în data de: 17.04.2011

Primit sub formă revizuită în data de: 16.06.2011

Acceptat în data de: 20.06.2011

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of teeth agenesis [11,12]. Hypodontia creates significant challenges to the clinicians in both diagnosis and management. Comprehensive management often requires a multidisciplinary approach.

There are different treatment alternatives for patients with a missing lateral incisor because of congenital reasons [16-18]. Esthetic and functional problems can arise when an orthodontic space closure is realized and the canine is moved into the missing lateral incisor's space [19-21].

If the morphological and functional conditions for orthodontic space closure are not present, space for the lateral incisor that has to be substituted must first be created orthodontically [22]. The edentulous ridge can later be restored with a bridge. The resin-bonded bridge should be given particular consideration for that purpose because of its low invasiveness for the adjacent teeth [22]. The complete survival ratio of resin-bonded bridges with anterior location is about 53% for 10.5 years [23,24]. In some cases resin-bonded bridges have to be rebonded or be succeeded by a conventional bridge, and healthy teeth have to be prepared [22]. With the introduction of osseointegrated implants, new, long-lasting space management, which is noninvasive for the adjacent teeth, can be realized [25]. Moreover, the canine's natural leadership function can be preserved [22].

Materials and Methods

When planning the treatment management of a patient with hypodontia, a key decision is whether to open the space to replace the missing teeth or to close the space and eliminate the need for prostheses. In the case of the reduced hypodontia, the general treatment objectives depends on the age of the patients, the association with other malocclusions and the esthetic requirements.

Many factors influence this decision, which has to be made on a case-by-case basis. Space opening is considered by some authors to be advantageous both functionally and occlusally, favouring good intercuspitation in the buccal segments [22], but its major disadvantage is that it commits the patient to a permanent prosthesis.

The appliance selected for space management depends on the type of tooth movement required. Active removable appliances produce mainly tipping movements and, although indicated occasionally, their application for space creation or closure is very limited.

The clinical and paraclinical factors to be considered when restoring an edentulous space are various and include [26]: esthetic factors, function, comfort, occlusal stability, speech, prevention, psychological factors.

An increased overbite is often present in patients with hypodontia, especially where the degree of hypodontia is significant [27,28]. In the overall treatment plan, reduction of the overbite must be taken into consideration when the anterior space is restored or when overjet reduction is required. The management of cases with missing maxillary lateral incisors has many options, which include

the replacement of missing teeth with a prosthesis or implant, both of them having their drawbacks. According to [29], the most esthetic and functional treatment option for management of a missing maxillary lateral incisor is canine substitution. When the canine is moved distally to open the space for the lateral incisor's implant, its root creates an adequate alveolar ridge through stretching of the periodontal ligament [30]. In a study of 20 patients with congenitally missing lateral incisors [29], observed the amount of change that occurred across the edentulous ridge by evaluating dental casts and tomograms. The amount of bone loss was less than 1% from the end of treatment up to 4 years after treatment. These minor resorptive changes of the ridge were described as the procedure of "implant site development" by orthodontic separation of two teeth. We will present three therapeutic options for space opening in three cases of congenitally missing maxillary lateral incisors. **Selecting the appropriate option depends** on malocclusion, specific space requirements, tooth-size relationship, and size and shape of the canine.

Case Report 1

The patient, aged 12 years and 9 months, came 6 months ago at the Department of Paedodontics and Orthodontics, University of Medicine and Pharmacy Victor Babeş, Timișoara.

The patient's major complaint was the missing teeth and the existing spaces. Her general medical and dental history were not significant and she had no family history of any oral or dental anomaly. The patient had no extractions. Extraoral examination revealed a well-balanced face with normal facial profile and class II tendency. Intraoral examination revealed a Class II malocclusion (Fig. 1), confirmed by the examination in all the 3 plans:

Sagittal plan

Right molars :dental class I

Left molars: dental class II

Canines: bilaterally distalized class II Angle

Incisors: no overjet

Transversal plan

Neutral relationships both anteriorly and posteriorly

Vertical plan

Neutral relationship posteriorly

Excessive overbite 1/1 at the level of the central incisors

Radiographic examination confirmed the congenitally missing upper lateral incisors. The skeletal base of the patient does not present modifications, confirmed by the lateral cefalogram tracings.

With the patient's approval, the objectives of the orthodontic treatment were to correct the malocclusion and align the teeth for later prosthodontic care, therefore a combined orthodontic–restorative–surgical team approach was adopted. The treatment plan consists of the space

opening for the implant supported restoration and also correcting the class II malocclusion in all three planes of space.

Considering the fact that the patient presented a dental class II we decided for sagittal expansion using the Distal-Jet appliance (Fig. 2). Five months after applying the device, we used a Roth Omni 0, 18 slot fixed orthodontic appliance, using the straight-wire technique (Fig. 3, 4). After reaching the treatment goals, an orthodontic Hawley retainer with dental units (because of the patients age) or an adhesive bridge with dental units will be used in the interim period between debonding and placement of final crowns. After reaching the age of 18, 2 implants will be placed in the 1.2 and 2.2 regions.

Case Report 2

The patient, aged 12, reported to our Department of Paedodontics and Orthodontics, University of Medicine

and Pharmacy Victor Babeş, Timișoara for functional and esthetic reasons.

Extra-oral examination revealed a well-balanced face with normal facial profile and skeletal dental base relations.

Intraoral examination revealed a class I malocclusion, with upper lateral incisors hypodontia, the canines placed mesially and mild crowding in the lower jaw. This aspect was confirmed by the examination in all the three plans:

Sagittal plan

Right molars: dental class II

Left molars: dental class I

Canine bilaterally distalized relationships with a false dental class II due to the mesial shift of the canines

Incisors: no overjet

Transversal plan

Neutral relationships both anteriorly and

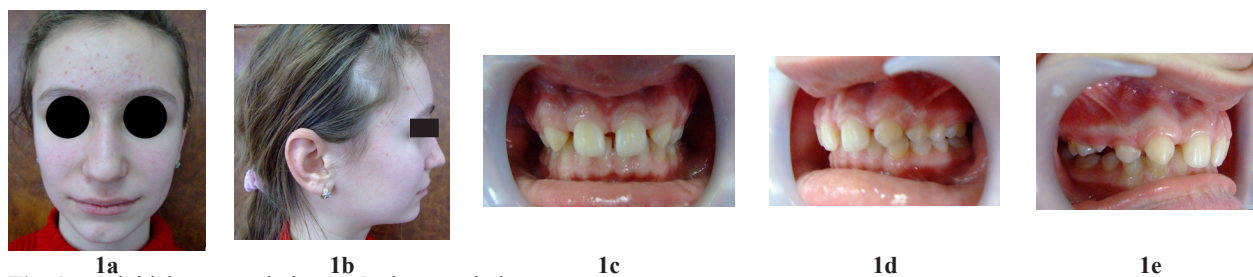


Fig. 1: a,b initial extra-oral view; c,d,e intra-oral view.



Fig. 2: a the Distal-Jet appliance; b, c, d initial aspect after the Distal-Jet application.



Fig. 3 Intra-oral view after 4 months.



Fig. 4 Intra-oral view after 6 months

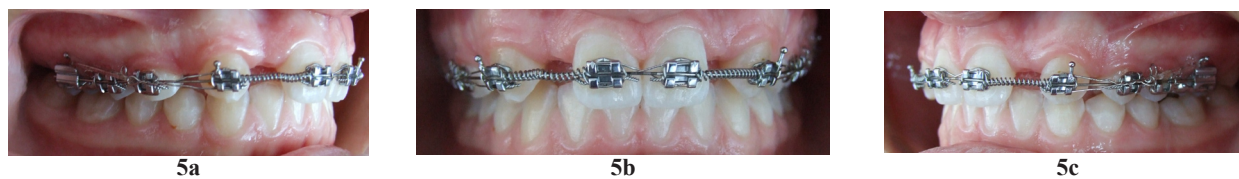


Fig. 5: a,b,c present intra-oral aspect with tie-back for canine traction in the obtained space, and coil spring for space opening.

posteriorly

Vertical plan

Neutral relationship posteriorly

Overbite of 1/2 at the level of the central incisors

The skeletal basis of the patient was class I, confirmed by the lateral cephalogram tracings.

The objectives of orthodontic treatment were: to open the space in order to insert dental implants for later prosthodontic care, to correct the excessive overbite and also to correct the relationship in all three planes of space. With the patients' approval, a combined orthodontic–restorative–surgical team approach was adopted.

The chosen orthodontic appliance was the rapid maxillary expander with spider-screw (Leone, Italy) (Fig. 7, 8). This decision was taken because we wanted orthodontic space opening in the anterior area, in order to place future dental implants and to maintain the posterior diameter unchanged (Fig. 9). Like in the anterior case, after reaching the objectives, an orthodontic Hawley retainer with dental units or an adhesive bridge with dental units will be used in the interim period between debonding and placement of final crowns. After reaching the age of 18, 2 implants will be placed in the 1.2 and 2.2 regions.

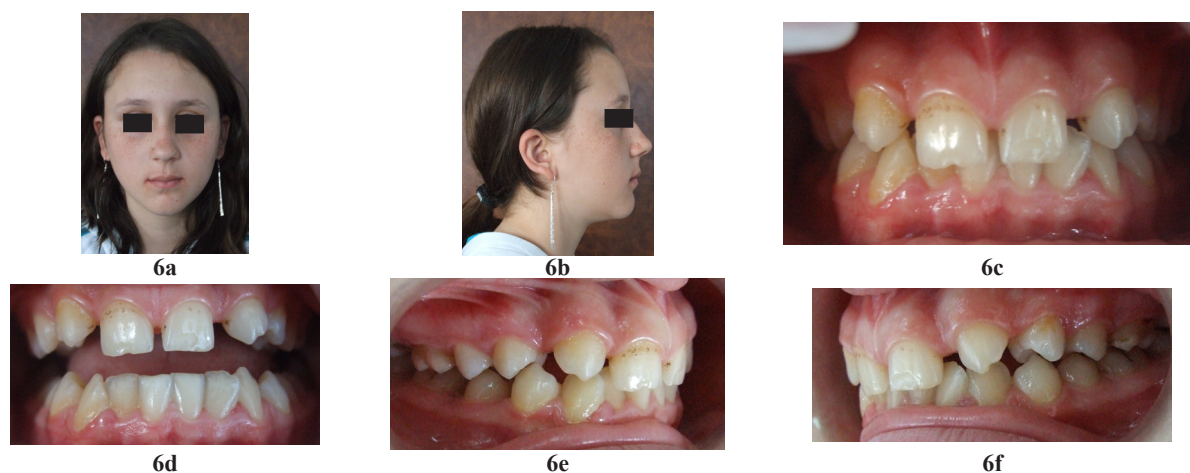


Fig. 6: a, b initial extra oral view of the patient; c,d,e,f initial intra oral view.

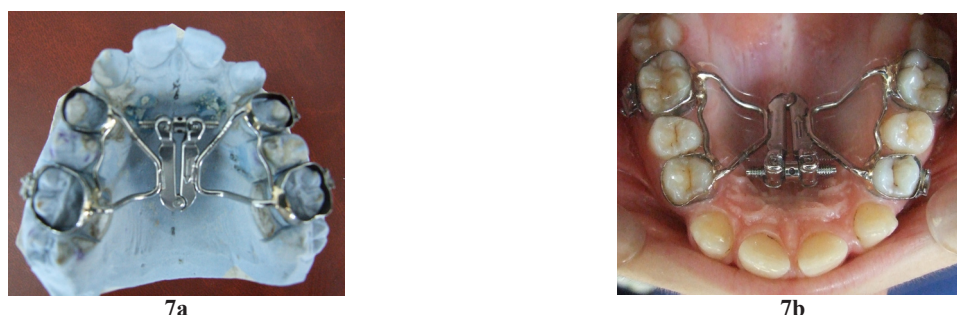


Fig. 7: a rapid palatal expander with a spider-screw on the study model and b cemented in the oral cavity.



Fig. 8: a, b, c, d intra-oral aspects after rapid maxillary expansion.

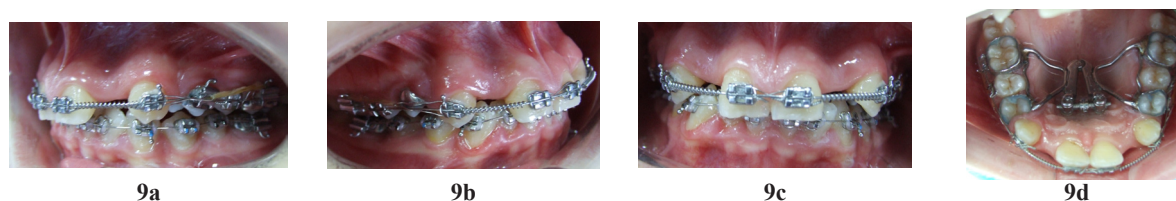


Fig. 9: a, b, c, d Present intra-oral aspects with the space opened for the future dental implants.

Case Report 3

The patient, C.A., aged 19, came at the Department of Paedodontics and Orthodontics, University of Medicine and Pharmacy Victor Babeş, Timișoara for esthetic reasons. The final diagnosis after the clinical and complementary exams was: congenitally missing upper lateral incisors and lower second premolars, excessive overbite, canine and molar class II relationship in the sagittal plane and skeletal class II tendency (Fig. 10, 11). The objectives of orthodontic treatment were to correct the class II malocclusion, opening the space to the upper lateral incisors and in the inferior arch to the left second premolar (in the right side the deciduous second molar is still present) and align the teeth for later prosthodontic care. Also a combined orthodontic–restorative–surgical team approach was adopted. The therapeutic plan after

consulting the patient was: orthodontic opening of space at the upper lateral incisors' level and insertion of two dental implants. The patient refused the use of orthodontic sagittal expansion appliances, accepting only the fixed orthodontic appliance, although she was informed of the difficulty of space opening at desired dimensions.

Initially the patient refused solving the situation in the lower arch expressing the desire to maintain the right second temporary molar and to close the existing space in the 3rd quadrant.

Roth Omni, 0, 18 slot brackets were applied (GAC) and we used straight-wire technique.

Finally, the interdisciplinary approach consisted of the insertion of 4 dental implants at the absent teeth level and implant supported restorations (Fig.12, 13, 14).



10a



10b



10c

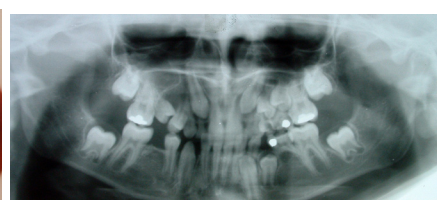


Fig. 11 Initial panoramic X-Ray 3 years before beginning of treatment.



12a



12b



12c



12d

Fig. 12: a space opened for dental implants; b,c intra-oral aspect after insertion of dental implants in the upper and lower jaw; d panoramic X-ray after the implant insertion.

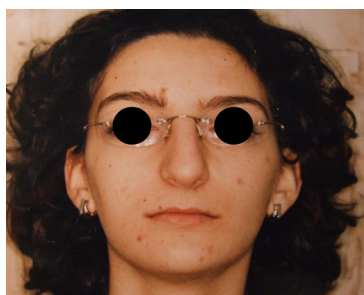


13a



13b

Fig. 13: a intra-oral view after the provisional restoration; b.intra oral view after the final restoration.



13a



13b

Fig. 14: a,b extra-oral view after the final restoration.

Discussion

These cases reports illustrate the need for a multi-disciplinary team approach, not only at the treatment planning stage, but also throughout the entire course of treatment. The main objectives in the management of any hypodontia case are to improve esthetics and restore masticatory function. Given that the patients presented themselves in early adolescence, the timing of treatment and the coordination of care were critical components. Orthodontic treatment involved significant time, as implants and final prosthodontic restorations had to be postponed until gingival maturation and skeletal development were complete [13]. The timing of extraction of retained primary teeth is also critical to the final result [13]. Sometimes, it is better to delay the removal of retained primary teeth to maintain the surrounding dentoalveolar bone until implants are feasible [13].

The treatment plan for missing teeth cases should be based on a comprehensive evaluation of the age, occlusion, and space requirements of the patient as well as the size and shape of the adjacent teeth [30]. Treatment for children with several congenitally missing teeth is challenging because the growth and development of the oral structures have to be taken into account.

One of the treatment options is the use of implants [31]. However, because of the residual facial growth in young patients, infraocclusion of the implant may occur as the implant becomes ankylosed to the alveolar bone [31].

The other treatment options include maintaining the deciduous teeth, extracting the deciduous teeth and allowing the space to close spontaneously, prosthetic replacement, and orthodontic space closure [31]. On the other hand, if donor teeth are available, autotransplantation is a viable option. If the autotransplanted teeth do not ankylose, they will promote alveolar growth along with the eruption process [32].

The space required for the prosthesis is usually determined by two factors. The first are the esthetics: for example an upper lateral incisor should be two thirds of the width of the upper central incisor [33]. The second factor is the occlusion. Ideally, at the end of treatment there should be a good Class I occlusion, with coincident centre lines and optimal overbite and overjet [33].

Since Branemark et al. [34] introduced the possibility of direct alveolar anchorage for the replacement of missing teeth, osseointegrated implants have been used successfully in dentistry for more than 30 years. Implants are predictable and successful means of replacing missing teeth by supporting crowns, bridges, overdentures and other maxillofacial prostheses. In longitudinal studies, conventional implant treatment has a success rate of 91 to 99% in the mandible and 84 to 92% in the maxilla [34]. Patients with congenitally missing teeth usually present in childhood, but implant placement usually has to be postponed until the completion of skeletal growth.

During the interim period, preservation of alveolar bone volume is important. However, in severe hypodontia with large edentulous spaces and no expected development of alveolar processes, exceptionally implants can be placed at an earlier age [34].

Conclusions

The therapeutic methods for orthodontic space opening in cases of congenitally missing upper lateral incisors that consist in rapid maxillary expansion or sagittal expansion associated with fixed orthodontic appliance, allowed a more rapid and efficient gain of necessary space in order to insert dental implants, compared to the orthodontic space opening using only fixed orthodontic appliance, especially in case of generalized mesialisation due to absent lateral incisors, with the canines next to the central incisors.

We decided to begin treatment in the first two cases before the age of 12, although literature recommends that orthodontic therapy for space opening should not be started before the age of 13 years so as to prevent the relapse and progression of bone atrophy.

Because all cases were females, and after 13-14 years of age the growth is at an end in general, rapid maxillary expansion is preferred (not contraindicated) to be done before this period of time.

The time of implantation should be close to the end of orthodontic treatment. As opposed to starting orthodontic space closure early, orthodontic space opening before implantation should be started late.

The scope of orthodontic and restorative management depends on the severity of the hypodontia.

Multidisciplinary referral or consultation is important in treatment planning. Planning for space management is best carried out before initiating orthodontic treatment.

Careful consideration should be given to the timing of extraction of primary teeth and, if possible, extraction should coincide with implant insertion.

These cases report illustrates the need for a multidisciplinary team approach, not only at the treatment planning stage, but also throughout the entire course of treatment.

The main objectives in the management of any hypodontia case are to improve esthetics and restore masticatory function.

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