Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 22s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Multidisciplinary Approach To Treatment Of Midline Diastema

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Cite this paper as: Rand Ghoul, Nidal Ghannam ,Abu-Shilabayeh Hanali,Abdulgani Azzaldeen,Abu-Hussein Muhamad, (2025). M Ultidisciplinary Approach To Treatment Of Midline Diastema. *Journal of Neonatal Surgery*, 14 (22s), 240-284.

ABSTRACT

Midline diastema is a space between the maxillary and/or mandibular central incisors. Midline diastema can be due to various causes such as genetic, environmental, and so on. Proper history taking and correct diagnosis of the etiology of the diastema is essential to ensure that the orthodontic correction is successful, and no future relapse takes place. The presence of diastema between the central incisors in the adult patient has esthetics and malocclusion concerns. Treatment depends upon the correct diagnosis of its etiology and early intervention relevant to the specific etiology . The present article presents the treatment of a 9cases with midline diastema

Keyword: *Etiology; midline diastema; stability, Gingival recession, periodontal surgery, orthodontic treatment, follow-up*

1. INTRODUCTION

"Diastema" is space between adjacent teeth . Midline diastemata (or diastemas) occur in approximately 98% of 6 year olds, 49% of 11 year olds and 7% of 12–18 year olds. In most children, the medial erupting path of the maxillary lateral incisors and maxillary canines, as described by Broadbent results in normal closure of this space. In some individuals however, the diastema does not close spontaneously.[1] The continuing presence of a diastema between the maxillary central incisors in adults often is considered an esthetic or malocclusion problem. [2]Midline diastema's can be physiological, dentoalveolar, due to a missing tooth, due to peg shaped lateral, midline supernumerary teeth, proclination of the upper labial segment, prominent frenum and due to a self-inflicted pathology by tongue piercing. Angle and Sicher stated that an abnormal frenum is a cause of midline diastema, while Tait in his study reported that frenum is an effect and not a cause for the incidence of diastemaThe extent and the etiology of the diastema must be properly evaluated.[1,2] In some cases interceptive therapy can produce positive results early in the mixed dentition. Proper case selection, appropriate treatment selection, adequate patient cooperation, and good oral hygiene all are important.8-10 Eruption, migration and physiological readjustment of the teeth, labial and facial musculature, development into the beauty conscious teenage group, the anterior component of the force of occlusion and the increase in the size of the jaws with accompanying increase in tonicity of the facial musculature all tend to influence closure of the midline dental space.[3] The mandibular diastema is not a normal growth characteristic. The spacing, though seen less frequently than maxillary diastema, often is more dramatic. No epidemiologic data have been published on its prevalence. The primary etiologic factor in mandibular diastema is tongue thrust in a low rest position. Many patients seek closure of a diastema for aesthetic reasons.[4] In the case of normal physiological development, diastemas of less than 2mm in nine-year-old children generally close spontaneously. If they do not do so, small diastemas (less than 2mm) can be closed with finger springs on a removable appliance or with a split Essix plate,

as described by Sheridan. In adults with wider diastemas, fixed appliances are required for correction so that crown and root angulations are controlled. [Fig. 1. A,B,C,D] The etiology, pathogenesis and diagnosis of maxillary median diastema have been somewhat controversial over the years.[1,2,4] The purpose of this paper is to review the published information and controversies regarding the etiology and treatment of the midline diastema in order to give the practitioner an overview to direct effective diagnosis and treatment.

B. MIDLINE DIASTEMA ETIOLOGY

Numerous etiological factors contributing to the development of midline diastema have been reported and discussed in the literature. There is no agreement on a single etiological factor[2,4]]. The prevailing view seems to consider its development as a multifactorial phenomenon .[1,2] To treat the midline diastema effectively, an accurate diagnosis of the aetiology and.[5

an intervention relevant to the specific aetiology is necessary. Timing of the treatment is important to achieve satisfactory results.[1,2,3] Most of the researchers do not recommend tooth movement until the eruption of the permanent canines. But in certain cases, where very large diastemas exist, treatment can be initiated early. The following are the well established and narrated causes and treatment options for the midline diastema in the literature

Fig. 1. Pretreatment intraoral photographs: A) frontal view; B) close-up frontal view; C) right side view; and D) left side view.

1.B-Physiological Physiological

Diastemata in the definition are considered to be the manifestation of tooth replacement preparation of maxillae [2, 4] . Studies of the lack of physiological diastema in children and adolescents showed that this symptom may be an expression of inadequate physical development and requires further general diagnostics. Most maxillary midline diastemas in the mixed dentition appear as a consequence of the growth in width of the jaws in preparation for the eruption of the larger permanent teeth.[3] The maxillary unerupted permanent canines lie superior and distal to the apices of the lateral incisor roots, and as they erupt they tend to force the lateral and central incisors towards the midline closing the space. In most cases a diastema of less than 2mm will close spontaneously unless the patient has generalised spacing of the dentition.The incidence of diastemas varies with the age group and the race studied.[1,3] Fig.2

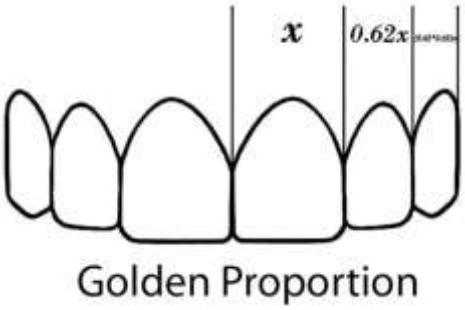

Fig.2 Golden Proportion Smile

Richardson and colleagues found the incidence at age 14 to be 12 per cent in white girls, 17 per cent in white boys, 19 per cent in black girls and 26 per cent in black boys[9]. Popovich and colleagues found that 83 per cent of patients with a diastema at nine years in the mixed dentition had no diastema at 16 years.[10] Besides the physiological diastema incisors

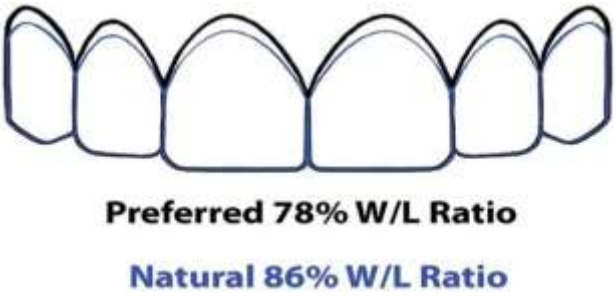

Fig.3. Preferred vs Natural W/L ratios

are usually fan-arranged – divergently, and because they do not look very aesthetic – this period, therefore, has been named as "ugly duckling stage"". In typically developing bite conditions the median diastema is gradually being closed during the eruption of lateral incisors and permanent canines [2, 11]. Therefore, the incidence of physiological midline diastema at age of 6 years is 98%, then it decreases to 49% at age of 11, at age of 12–18 years incidence of space between the central incisors is 7% [12]. According to Edwards [12] diastema of size not exceeding 2 mm is prone to spontaneous closure without requiring the implementation of the orthodontic appliance therapy. Bennet [13] believes that the treatment may be indicated if the child does not accept the appearance or when in the dental arch there is no space for lateral incisors. Space greater than 2 mm may require surgical intervention within the frenulum tissue [11, 14, 15]. Extreme caution should be taken when planning the closure of the diastema during the phase of bite formation. Fig. 3Unnecessary therapeutic intervention using removable orthodontic appliance can cause root resorption of lateral incisors, and can even stop erupting canines [16]. In some cases it is advisable to use elements of fixed orthodontic appliances in order to move and set parallelly the incisors [16]. Many authors believe that what is difficult is not the treatment for diastema closure, but the prevention of recurrence of this irregularity [11, 17].

2.B-Abnormal labial fraenum;

An abnormal fraenum might be defined as one exhibiting excessive thickness and alveolar attachment between the maxillary central incisors and apparent continuity with a large incisive papilla (Fig. 01). A large persistent fraenum has been traditionally associated with midline diastema but the relationship between the two may have been overstated in the past. Edwards found a strong correlation between an abnormal fraenum, together with vertical osseous cleft on x-ray and the presence of a midline diastema. [10] Popovich and colleagues, however, found no such relationship.[32] Bergstrom and colleagues in a longitudinal evaluation of a group of nine year olds with abnormal fraena revealed no difference in spontaneous closure whether or not a fraenectomy had been carried out. There appears to be broad consensus, however, that when there is a v-shaped radiolucency ("notch") in the crestal bone, on x-ray combined with a largediastema (more than 2mm), and a thick fleshy fraenum, then a fraenectomy is indicated .[18] Popovich et al. (1977a,b) argued that in cases with diastema, the hypertrophic frenum continues to develop more coronally as the alveolar process growths with teeth eruption, because the dentition exercises minimal or no pressure on the frenum[18,19]. Tait (1924)41 supported that the frenum has no effect on the maxillary incisors.[20] Ceremelo (1953) concluded that the presence of the frenum is not related with the presence or the width of the midline diastema[21]. Finally, Bergstrom et al. (1973) noted that the probability of long-term spontaneous diastema closure in patients with an abnormal frenum is the same, regardless of whether or not the frenum had been surgically excised. Consequently, further research is needed to determinethe cause-effect relationship between the abnormal labial frenum and the maxillary midline diastema.[22]Miller(1985) recommended that the frenum should be characterized characterizedas pathologic when it is unusually wide or there is no apparent zone of attached gingiva along the midline or the interdental papilla shifts when the frenum is extended. However, evaluating the frenum (normal or pathologic) is sometimes rather difficult, especially in borderline cases.[36] All clinical data should be assessed in relation to patient"s age, as well as to other parameters relevant to the problem.[18,19,20,21,22]

3.B-Missing maxillary lateral incisors

This can allow maxillary central incisors to drift distally. There are no physiological pressures placed on these teeth to close together as the canines erupt (Fig. 02a-c) . The diastemas due to congenital absence of lateral incisors can be treated orthodontically with closure of the diastema and proper guidance of the canines to the position of the missing lateral incisors and of the posterior teeth mesially. [24]In such cases, it is obligatory to achieve an Angle II occlusal relation. Selective grinding of the incisive and palatal canine cusps and of the palatal cusps of the first premolarsand restorations with resin composite must be performed in order to transform canines and first premolars into lateral incisors and canines,

respectively.[25] This is essential for satisfying patient‟s esthetic requirements, as well as properfunction of the stomatognathic system[1,2]. Alternative treatment options for the maxillary midline diastema caused by congenitally missing lateral incisors are to close the diastema and create the appropriate space for placing toothsupported restorations or single-tooth implants. [24] The last options are of particular significance in cases of unilateral tooth absence, mainly because of the difficulties faced during orthodontic treatment, when trying to achieve dental arch symmetry[25]. The selection of the appropriate treatment option in cases with congenitally missing lateral incisors, depends on the present malocclusion, on the anterior teeth relationship, on the specific needs concerning the available space, on the conditionof the adjacent teeth, on the tooth-size relationship and on the size and shape of the canine.[24,25,26] The diastemas due to congenital absence of lateral incisors can be treated orthodontically with closure of the diastema and proper guidance of the canines to the position of the missing lateral incisors and of the posterior teeth mesially. In such cases, it is obligatory to achieve an Angle II occlusal relation. Selective grinding of the incisive and palatal canine cusps and of the palatal cusps of the first premolars and restorations with resin composite must be performed in order to transform canines and first premolars into lateral incisors and canines, respectively. This is essential for satisfying patient‟s esthetic requirements, as well as properfunction of the stomatognathic system[1,2,3,4]. The last options are of particular significance in cases of unilateral tooth absence, mainly because of the difficulties faced during orthodontic treatment, when trying to achieve dental arch symmetry. [27]The selection of the appropriate treatment option in cases with congenitally missing lateral incisors, depends on the present malocclusion, on the anterior teeth relationship, on the specific needs concerning the available space, on the condition of the adjacent teeth, on the tooth-size relationship and on the size and shape of the canine.[1,2,3,4]

Fig.4´.Diastema Closure

B-ECTOPIC MAXILLARY CANINES

The absence of the canines from their normal position can facilitate distal drift and tilt of the incisors with space opening and there is the associated lack of the physiological pressures to upright the lateral and central roots that normally closes the diastema.[28,29,30,31,32]

5.B-Tooth size or shape discrepancy

The most commonly presenting of these are small lateral incisors. The Bolton Analysis may be used to compare tooth sizediscrepancies. This group are the most amenable to restorative and prosthetic solutions.[33]

The associated shape discrepancies most frequently seen are central incisors that are excessively triangular or have mesial surfaces that are either concave or convex.

The mesiodistal widths of the anterior teeth and the arch width should be measured. These measurements should be compared with the norms to determine whether it is contributed due to tooth size discrepancy, check whether all four incisor are small or only the lateral incisor are smaller with normal sized central incisors .Approximate mesiodistal widths of the anterior teeth and approximate arch widths , both in mm , are given in tables respectively . Fig.4 If only the lateral incisor is small, the Diastema should be closed orthodontically by moving the central incisor together reciprocally. Then the lateral incisor position can be corrected orthodontically and tooth size can be restored by composite build up or placement of crowns over lateral incisors.[1,2,3,4,5] Fig.5

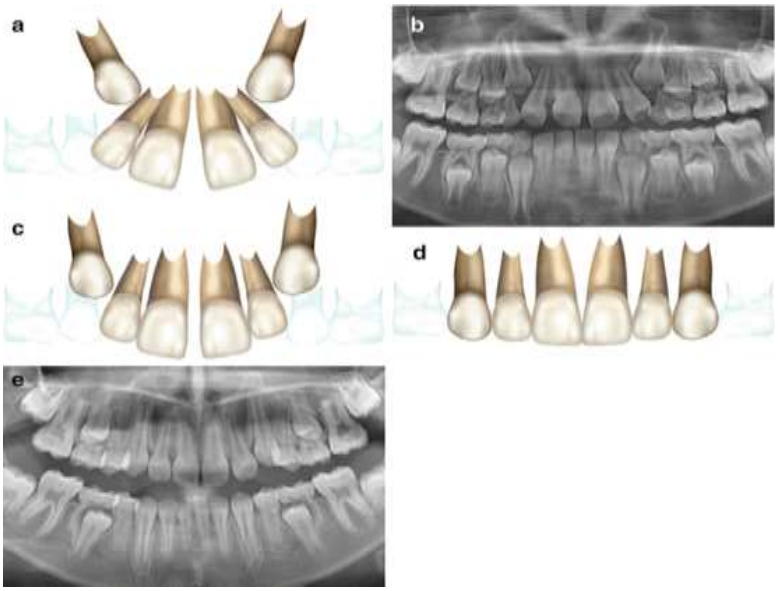

Fig. 5.Ugly duckling stage. (a, b) Obvious distal inclination of the maxillary incisors creating a midline diastema in the mixed dentition. (c) Maxillary incisors tend to upright by the eruption of the permanent canines and the midline diastema reduces. (d, e) Spontaneous closure of maxillary midline diastema after the canines are fully erupted

6.B-Mesio-distal angulation of incisors

a.Root convergence Distally inclined incisors can produce a diastema with the tooth space positioned towards the incisal edges of the incisors[1,2,3,7]

b.Root divergence Mesially inclined incisors can result in a coronally positioned contact point and a diastema, which is more gingivally placed . This is often referred to as the black triangle and is associated with reduced papilla infill, so that in effect it is a diastema that is closed off at its incisal aspect by contact of adjacent teeth. Burke and colleagues[39] in a study found that 40 per cent of crowded maxillary incisors can be expected to produce a black triangular space at the midline after fixed appliance treatment unless something is done to close this space before appliances are removed and the case considered finished(Fig. 11).There is a high incidence of concave mesial surfaces in crowded maxillary incisors, which becomes more apparent as the teeth are decrowded orthodontically (Fig. 12). Tarnow and colleagues[40] in a study on the effect of the distance from the contact point to the crest of bone on the presence or absence of an interproximal dental papilla found that: • when the distance was 5mm or less the papilla was usually present (Fig. 13a) • when the distance was 6mm the papilla was present 56 per cent of the time (Fig. 13b); and, • when the distance was 7mmor more the papilla was present 27per cent of the time or less .[1,2,3,4,5,6,7] Fig.5

7.B-Inter arch Relationship

When the combined width of the mandibular anterior teeth is very large and the combined mesiodistal width of the maxillary teeth is less, then the lower arch is well align but it does not relate with the upper arch[1,2,7]. Thus, labial positioning of the upper anterior with spacing in between upper teeth presents to match the upper arch with the well aligned lower arch. Such a case would require inter –proximal enamel reduction from lower anterior teeth or extractions of lower second premolars followed by fixed orthodontic appliances in both the arches. After the spaces are closed in the lower arch, the maxillary incisors should be retracted. This would reduce or eliminate the Diastema in the maxillary arch.[34,35]

8.B-Habits

The most frequently implicated habits are thumb, digit or soother sucking. These have a tendency to procline the maxillary labial segment, which may lead to spacing and diastema in some patients.[1,2,7,41] Oral habits such as tongue thrusting and finger sucking can be other aetiological factors for the appearance of the midline diastema.[32,33]]According to Proffit andFields, tongue position at rest may have a greater impact on tooth position thantongue pressure, as the tongue only briefly contacts the lingual surface of the anteriorteeth during thrusting. The tongue pushes the anterior teeth to a forward position,increasing the circumference which results in spacing [36].An abnormal habit of the tongue can be detected by the tip of the tongue popping out through the anterior spacing when the patient is asked to swallow. In cases of anterior open bite, the tongue may be seen thrusting between incisal edges of the maxillary and mandibular incisors. Patients with tongue thrust often produce a snap sound on swallowing and also have hyperactivity of the orbicularis oris muscle. An abnormal tongue size is a severe problem which may create difficulties in retaining the orthodontically corrected midline diastema. Macroglossia can be detected by simple observations.[1,2,4] The patient can be asked to touch the tip of the nose with his

tongue and, if he/sheis able to do that, it is an indication of an extended tongue . In the same way, if tooth indentations are seen on the lateral borders of the tongue, it can be an indication of an enlarged tongue In such cases, surgical trimming may have to be considered in order to attain stability in the dental occlusion.[37]Deleterious habits have to be corrected by using habit-breaking appliances and by psychological approaches. The use of fixed tongue cribs are found to be effective in breaking the tongue-thrusting habit.[38]

9.B-Tooth Anomalies and other Pathologic

Lesions in the soft or Hard Tissues in the midline Generally, mesidens is present as a supernumerary tooth in the hard or soft tissue and acts as an impediment in the eruption of permanent central incisor in their correct position and also approximation of these teeth is not possible because of its presence .again any fibrous cystic or bony lesion may also be present .radiographic assessment with intraoral periapical x-rays and upper occlusal views are recommended. Extraction of supernumerary tooth should be carried out before commencing orthodontic treatment .surgical excision in the case of pathological lesion is necessarily done and zinc oxide eugenol dressing for two weeks is placed post surgical at the site of the surgery. Orthodontic correction should follow the removal of the pathological cause.[1,2,7,41]An odontogenic keratocyst can appear in the maxilla and can displace teeth, leading to spacing in the anterior region. A median palatal cyst is another midline structure which is a rare cyst originating from the epithelium trapped along the line of fusion of the lateral palatal maxillary process during development.[39] Odontomas are benign odontogenic tumours composed of enamel, dentine, cementum and pulp tissue. Odontomas are the most frequent odontogenic tumours, with an incidence of 22−67% of all maxillary tumours. They are usually asymptomatic, butoften associated with tooth eruption disturbances. Odontomas can be presentbetween the roots of erupted maxillary central incisors, preventing contactbetween their crowns and causing large diastemas. A radiographic examinationof the site will be beneficial in cases of a large diastema to rule out the presence ofany midline lesions such as odontomas, when the presence of other commonaetiological factors are not observed. The treatment of choice is surgical removalof the tumour and closure of the midline diastema using composites, jacket crownsor orthodontic appliances, depending on the size of the diastema . [40]

10.B-Development ;A maxillary midline supernumary is a rare cause of midline diastemain children. Permanent maxillary central incisors can normally erupt with a diastema that will be reduced in size with the eruption of the lateral incisors and will completely disappear with the eruption of the canines. This happens because each permanent incisor and canine is 2-3 mm wider than its primary predecessor. Therefore, the maxillary midline diastema is frequently, not only physiologic, but necessary. If there is no pathological condition related to these specific teeth or major deviations from normal teeth size, spontaneous closure of the diastema should be considered certain in most cases. If, however, this does not happen, then intervention by the dentist may be necessary.[2,10,38,31,39,40]

11.B-Combinations

Not infrequently a number of the above factors combine in one patient to produce a diastema.[41]

12.B-Iatrogenic:

rapid maxillary expansion can cause midline diastema due to opening of the intermaxillary suture.[1,2,3,4,28]Moyers stated that imperfect fusion at the midline of premaxilla is the most common cause of maxillary midline diastema. The normal radiographic image of the suture is a V-shaped structure(Fig. 6, b).[7]

13.B-Genetic of midline diastema

The genetic nature of midline diastema International literature includes few reports on genetics or heredity as etiological factors for the development of the maxillary midline diastema.[42,43,44]Gardiner discusses the etiology of the persisting midline diastema and notes that there is "almost no limitation concerning contributing factors. Undoubtedly, hereditary causes are high up the list and we have all seen parents and offspring with this feature".[45]Schmitt (1982) described eight members of a family who, for more than three generations, presented a syndrome including bilateral triphalangeal thumbs, radial hypoplasia, hypospadias (congenital abnormality of the urethra) and maxillary diastema. All family members with the disease had a midline diastema and the authors concluded, on the basis of the hereditary pattern, that the syndrome follows the autosomal dominant type. The authors did not discuss the role or the correlation of the maxillary diastema with the syndrome, nor did they further elaborate on the genetic contribution possibly responsible for the expression of the dental hereditary feature.[46] Harris and Johnson (1991) also examined the role of heredity in abnormal dental occlusion. The authors, in a longitudinal analysis of relatives, investigated both craniometric and occlusal variables. The study was based on serial evaluations of cephalometric radiographs and dental casts of 30 relatives (4 to 20 years old) with no previous orthodontic treatment from the Bolton-Brush Growth Studies in Cleveland, Ohio. The aim of the study was to evaluate the contribution of heredity to a variety of craniofacial, skeletal and occlusal variables. The authors concluded that craniometric variables are correlated with high heredity values, whereas almost all occlusal variability is more acquired and less hereditary.[47] Neville et al. (1997) describe the thyroglossal cyst of the duct as a remnant of the thyroglossal duct epithelium that normally undergoes atrophy and is eliminated. Occasionally, however, it remains and forms a cyst. They also report that thyroglossal duct cysts appear in the midline and may develop from the foramen tongue caecum to the superior fissure. The

median palatal cyst is another midline structure, which Neville et al describe as a rare cyst originating from epithelium trapped along the line of fusion of the lateral palatal maxillary processes during development.[39] Nainar and Gnanasundaram (1997), in their study of midline diastemas in a South India population sample, examined 9774 individuals from 13 to 35 years of age in order to determine the consequences and possible etiological factors of this feature. The relatively increased frequency of familial occurrence led the authors to propose the presence of a genetic factor contributing to midline diastema expression.[48] Shashua and Artun (1997) report that genetic predisposition is a probable precondition contributing to midline diastema development. The authors concluded that the family tree of diastema was one of the only two important risk factors for diastema relapse. The other factor was diastema size before treatment.[49] Gass et al. (2003) note that preliminary results from thirty families show a possible genetic basis for this diastema. More specifically,"heritability" was estimated at 0.32 for the white and 0.04 for the black population. "Heritability " is defined as the ratio of the total genotypic diversity to the total phenotypic diversity with values ranging from 0 to 1. Data from family trees suggest a dominant autosomal hereditary type.[50]

14.B-Periodontal Status

The amount of bone support for each tooth should be of special consideration in children with juvenile periodontitis and adults with periodontal problems. Localized juvenile periodontitis is an aggressive periodontal disease, which is seen in teenagers. It is characterized by loss of tissue attachment and loss of alveolar bone around the permanent incisors and first molars. One sees a dentilabial migration of the maxillary incisors as a result of excessive bone loss forming a midline diastema. [41,51] The first line of treatment is to control the disease by periodontal therapy like scaling, root planning and with anti-microbial agents like tetracycline and metrogyl. In most cases, consultation with a periodontitis is a must[52,53]. A close collaboration between the orthodontist and theperidontist is desirable. Ideally the treatment of juvenile periodontitis should include correction of systemic condition along with the localized measures. In advanced stages of the disease, it is difficult to retain the teeth in function but in early stages, the disease can be eliminated and the dentition can be retained. The only contraindication to orthodontic treatment for this persistence of gingival inflammation and severe bone loss in spite of adequate phase I periodontal therapy, which includes preparation of tooth surface, plaque control, antimicrobial agents, and control of uncomplicated gingivitis. In adult seeking orthodontic closure of anterior spacing, it is assumed that bone remodeling process may occur more slowly. So, for both teenagers with initial stages of localized juvenile periodontitis and adult with or without periodontal problems, phase I periodontal therapy procedures are finished first, preferably by a periodontist. Orthodontic treatment should be started only after the inflammation of the gingival has reduced to a minimum by the phase I periodontal therapy. [51,53,54,55] Major occlusal adjustments and periodontal surgical procedures are performed after completion of orthodontic space closure as firstly , orthodontics may change the shape of periodontium reducing the extend of surgery and secondly , the removal of supracrestal fibers during surgery will facilitate retention. Generally to correct pathologic tooth migrations of anterior teeth, a tissue borne removable appliance with a labial wire or light elastic attached to the hooks embedded in the acrylic at the distal surface of each canine is used[54,55]. These elastics are engaged below the brackets or buttons on the incisors. this would produce light and intermittent forces that would intrude as well as retract the anterior teeth closing the diastema .these light and intermittent forces are ideal for the closure of diastemas created by pathologic migration of anterior teeth .in adult patients, when there is loss of periodontal attachment, surface area of supported root becomes smaller and the center of resistance also becomes further. So, for tooth movement light forces with relatively large moments are needed.[1,2,3,55]

C.The prevalence:

Numerous studies have investigated the frequency/prevalence of diastema. Consequently, there was a wide range of findings from 1.6% to 25.4% in adults and an even greater range in groups of young people [1,2,3,56]. Differences in epidemiological study findings may be attributed to the increased number of factors contributing to midline diastema, to the definitions used to explain its presence and to gender and race differences in the distribution of the hereditary feature in question.[13] The incidence of midline diastema varies greatly with the age group, gender, population and race. This condition is very common in the paediatric age-group at the early stages of dental development [57,58].The diastema remains after the eruption of the permanent incisors and canine, such may not close on its own [1]. Oesterle and Shellhart, in 1999, reported 97% incidence in 5-year-old patients, and this decreased with age [59]. While midline diastema was found in 37% adolescent in Nigeria[60]There are divergent views on diastema. The aesthetic importance varies in relation to culture, age group and racial background. Influenced by such culture and social forms, individuals without a diastema may desire to have it created through cosmetic dentistry, while some others with diastema would rather want it closed or removed, because they find it aesthetically displeasing. [2,3,4]. In Africa, maxillary midline diastema is regarded as an attractive dental feature, a sign of beauty, especially in the females, and is used as notable successful trademark[4]. Meanwhile, a study by Oboro et al in 2008 reported that majority of patients interviewed did not support the artificial creation of midline diastema [61].The incidence of median diastema found in current study is close to that found in Kuwait (26.8%) [62]. A study among Turkish population showed that midline diastema was observed in (4.5%) of the patients and it was almost equally distributed between the females and males, 35 in females and 33 in males [63] ,whereas a study among Tanzanians found the incidence to be 26%,

11% and 8% for maxillary, mandibular, and both arches midline diastema respectively [64]. These figures were lower in these populations than in the current study. The percentage of median diastema 12.59 % is considerably higher in a study done in Pakistan [65] as compared to prevalence in United Kingdom 3.4 % of Caucasians and 1.6 % of South Indians. The prevalence of median diastema varies in different population groups. In the earliest study, Taylor reported that the prevalence of median diastema was 7% among Californian children ranging in age of 12-18 years[66]. In two studies on Caucasian children in the United Kingdom a prevalence of 6.8% and 3.5 to 4% was reported by Weyman and Gardiner[67,68]. In a comparative study of children Horowitz reported a prevalence of median diastema of 8% for Caucasians and 19% forNegroids . In a comparative study of adults, Lavelle reported a prevalence of 3.5%, 3.4% and 5.2% for Caucasians, Mongoloids and Negroids respectively . Mc Vay and Latta studied median diastemas radiologically considering a space of more than 0.5 mm as positive for the trait[68]. They observed a prevalence of 9.6%, 12.5% and 16.3% for median diastema of 0.5 to 1.49 mm for Caucasians, Mongoloids and Negroids respectively. In the same study a prevalence of 10.4%, 7.6% and 12.9% was observed for median diastema of more than 1.5 mm for Caucasians, Mongoloids and Negroids respectively. The high prevalence for all racial groups in the above study may be due to the radiological method enabling the detection of median diastema of 0.5 mm. However, the prevalence for the Caucasian-Mongoloid groups is similar to tlie Negroids, being relatively higher as in the earlier studies of Horowitz and Levalle who used the direct method .[67,68] The prevalence of the diastema in female was more than male. This result disagree with Nainar and Gnanasundaram [69] and Al-Huwaizi [70] which found that the prevalence of midline diastema in male more than female. Genetic factors most likely play a leading role in male-female differences. Omotoso and Kadir was found that maxillary midline diastema occurs more frequently than mandibular midline diastema, and that females are more likely to have a maxillary midline diastema, while males are more likely to have a mandibular midline diastema. Diastema runs in families, and it is suggested that male children are more likely to inherit it [1,2,3,71].

D. Treatment of median diastema:

Initiation of orthodontic treatment to close diastemas should be done after close evaluation of certain aspects of the problem. The specific question to be answered is: Does the diastema affect esthetic and speech, and is the patient aware of its presence? If he is self-conscious about it, does he want to do something about it? Next, is the diastema self-cleansing, or are food impaction and inflammation of the interdental tissues present? Finally, if spaces are mechanically closed, would they stay closed or would they relapse? [72] Fig.6

Fig.6Closing a Large Maxillary Median Diastema using Bapat Power Arm.

The search for perfect proportions has engaged people for a long time. Even the ancient Greeks tried to find the ideal proportion which rules the world. The look of a smile is affected by two ratios: the first is the proportion of the width of upper front teeth in relation to each other and the second ratio is the height-towidth proportion The proportions of the teeth in relation to each other in a smile are described by the golden proportion otherwise called the divine proportion . Because of the curvature of the dental arch, the visible widths of upper front teeth are different then real widths. According to the theory of the aesthetics of the smile, the best considered width of the lateral incisors should be 62% of the width of the central incisor and the canine apparent width—62% of the width of the lateral incisor. Ideal central incisor width-to-height proportion should be 75–78% or 80% and it depends on teeth length . In this study the scope of the W/L ratios was higher and amounted to 92–100%. [1,3,4]

A. Treatment of diastemas not caused by orthodontic treatment:

Fig.7.Direct closure of the multiple diastemas we created using composite resin restorations, thus eliminating the need for tooth preparation

1. Diastemas present as part of the manifestation of the normal development stage of the dentition should not be closed for fear of deflecting the roots of the maxillary central incisors in the path of eruption of the lateral incisors.[1]

2. Diastemas caused by supernumerary teeth, cysts between the teeth, or the presence of a fibrous epulis pushing the teeth apart should not be closed before removal of the pathologic condition.[2]

3. The prognosis for diastemas caused by habits (thumb- and finger-sucking, lipbiting and tongue-thrusting) may range from good to poor, depending on whether the patient is willing and / or able to stop his deleterious habit.[1,3]

4. If an abnormal labial frenum is diagnosed as the cause of the malocclusion, surgical excision or permanent retention by splinting together of the teeth should be considered.[73]

5. Diastemas resulting from migration of teeth in residual spaces from congenitally missing or extracted teeth may be treated by one of two different approaches: a. Use of an orthodontic appliance to open the space for the missing tooth, followed by bridging of the space. b. Orthodontic closure of all spaces in the arch.[1] Fig.7

6. Peg-shaped maxillary lateral incisors may cause diastemas to open between the neighboring teeth through lack of proximal support. The peg-shaped lateral incisors may be extracted if the root is short or resorbing and then treated as stated above, or, if the roots are of good size and shape, a crown can be constructed after orthodontic movement of the teeth to their proper positions. In the latter case, very little or no relapse should be expected.[74]

7. Diastemas caused by rotated teeth are difficult to retain after closure because of the tendency of the rotated teeth to return to their original positions.[1,2,3]

8. Generalized diastemas between the teeth caused by microdontia are difficult to close and retain. In general, complete closure of spaces is not advised. Two alternatives are suggested: no treatment or full mouth reconstruction if it is esthetically or functionally needed and feasible.[1,2,3,4]

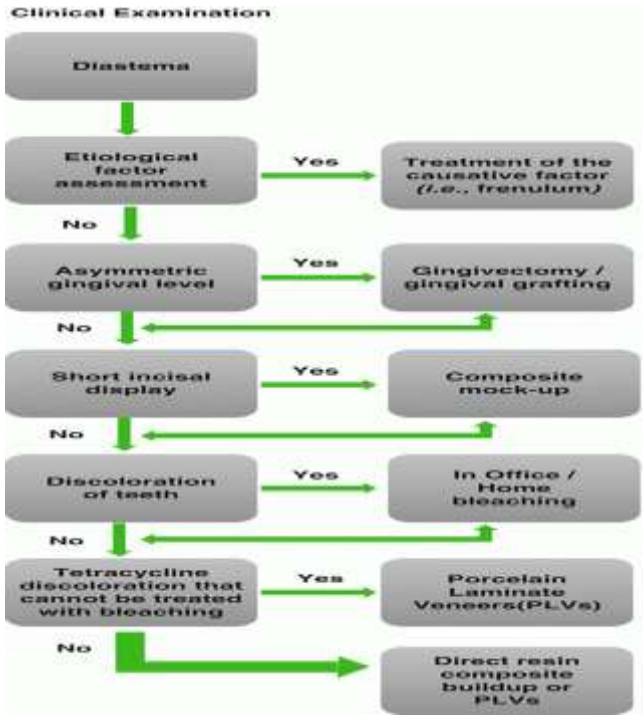

Fig.8; Restorative treatment chart for the diastema cases in clinical applications

B. Treatment of diastemas associated with or appearing after ortho dontic treatment :

1. Teeth which have been tipped into extraction sites during treatment will tend sometimes to upright when the wires are removed. Fig. 8

2. Constricting the dental arches and encroaching on the tongue space by moving the teeth into an unbalanced position between the lingual and buccal musculatures is an invitation to relapse and space opening. It should be remembered that the teeth in malocclusion are in a state of balance, and unless their new position is in another state of balance with the surrounding

environment post treatment changes are to be expected. Suggested that the relapse may be a major problem following closure of midline diastema that persist after the eruption of permanent canines. To minimize relapse, permanent retention in the form of bonded wires, restorative options and even small powerful magnets bonded to the mesiopalatal surface of central incisors has been proposed. [75]The ultimate success in keeping the spaces closed after removal of the active appliance and retainers will depend upon the following factors:

1. Removal of the cause of the diastema, when possible.

2. The inherent tendency of the tissues, whether periodontal or muscular, to regain their original shape and position, either partly or completely.

3. Whether the new tooth position is in balance with the surrounding tissues and also on whether retention time was enough to allow adaptive changes in the tissues to occur, thus stabilizing teeth in their newly acquired positions.

4. The fulfillment of all orthodontic treatment objectives, including the positioning of the teeth in a balanced position with optimal interdigitation and axial inclinations. These three factors, separately or combined, will greatly influence prognosis of median diastema treatment .[74]

2. .Alternative approach for diastema closure other than orthodontic treatment:

Treatment of diastema varies and it requires correct diagnosis of its etiology, and early intervention relevant to the specific etiology. Correct diagnoses include radiological and clinical examinations and possibly tooth size evaluation.[1,2,3,4]

***Fig.9*;RESTORATIVE PHASE**

No treatment is usually done, if the diastema is physiological/transient as it spontaneously closes after the eruption of permanent maxillary canines.

Spontaneous correction of a childhood diastema is most likely when it width is not more than 2 mm. Fig.9

Fig.10;Before and After

• Pathological causes like supernumerary teeth midline soft tissue anomalies can be removed surgically and spaces are closed orthodontically. Oral habits such as thumb sucking and tongue thrusting should be corrected before closure of the space.

• Esthetic approach: patient demand for aesthetic dentistry with minimally invasive procedures has resulted in the extensive utilization of freehand bonding of composite resin to anterior teeth. When the teeth are in proper orthodontic alignment, no preparation of the tooth structure is necessary. If there is an alignment problem, minor tooth preparation will be necessary to achieve proper arch form .[72,73,74,75] Fig.10

-ESTHETIC APPROACH:

Patient demand for aesthetic dentistry with minimally invasive procedures has resulted in the extensive utilization of freehand bonding of composite resin to anterior teeth. Dental patients are more conscious of their appearances and have raised the importance of the smile within society as a whole; this impacts full mouth restoration as well as more conservative restorative procedures that include class IV restorations, veneers and diastema closure.[1,2,3,4,76,77,78,79] The diastema presents itself to the dental office on a regular basis. It may be small or large. Fig.11a,bThe papilla may be long and skinny or blunted. The size will have an effect on what material will be chosen to achieve the desired

Figures 11a and 11b. Gürel's illustration of interproximal reduction technique. (With permission to reprint. Gürel G. Porcelain laminate veneers for diastema closure. In: Gürel G, ed. The Science and Art of Porcelain Laminate Veneers. Chicago, IL: Quintessence Publishing; 2003:371-372.)

results.[76] When dealing with a large space closure, orthodontist may be indicated to allow for a more esthetic outcome. When the teeth are in proper orthodontic alignment, no preparation of the tooth structure is necessary. If there is an alignment problem, minor tooth preparation will be necessary to achieve proper arch form. Composite resin is an ideal material when restoring diastema closure. It is highly polishable, long lasting and mimics natural tooth structure. It is a conservative alternative to an indirect restoration.[76,77,78,79] Frazier-Bowers and Maxbauer listed various treatmentoptions for diastema closure which are as follows[79,80,81,82]:

1. Keep the diastema
2. Diastema closure with direct composite resin
3. Orthodontic treatment to move the teeth and close the diastema
4. Use porcelain veneers to close the diastema
5. Crown and bridge to close the diastema, which is usually done in adults
6. Make the patient aware of the habit and plan for habit breaking appliance
7. Remove the underlying pathology surgically, and then continue with closure of diastema with restorative material.

Schwartz et al [83]explained the Biomimetic Rules to create natural appearing diastema closure.According to the author, anatomically, the cusp of an anterior tooth is governed by the rule of three; which states that each cusp is composed of three developmental lobes mesial, distal and central; and each lobe possesses character that defines itself and its control over its anatomic position. First the space in between the teeth is measured, then that measurement is divided into half. The quotient is added to the existing width of each tooth which gives the new tooth width. This new width is divided into thirds, mesial lobe will occupy one third, and central and distal lobe will occupy the remaining two thirds. Author also stated that the width of the maxillary incisors are two millimeters less that their length, the contact of the anterior teeth is in lingual half of buccolingual dimension and the most apical aspect of anterior contacts should be between three to five millimeters to the interdental crestal bone to avoid black triangles and impingement of the biologic width. In cases which involve closure of complex diastema, determining the proper proportions dictates the amount of distal proximal reduction; whether to completely veneer the teeth or add to the interproximal zone; the number of teeth to be treated; and the position of prominences and concavities.[86] Special attention must be made if there are any occlusal concerns like bruxing or deep bite as direct restorations may not be Successful.[87] To close the complex diastema indirect techniques are used, they generally require multiple visits to enable proper placement of the laminates, crowns, or bridgework, and such procedures may also involve significant financial expenses After the restoration if patient is not happy with the outcome, the restoration can be removed without damaging the tooth structure. [79]The cost of treatment is very less in comparison with other treatment options like orthodontic treatment, veneers and crown. The time taken to close the gap is also very less as it can be done in a single visit when compared to other treatment option like indirect veneer and crowns which cannot be done in single visit and requires minimum of two to three visits whereas orthodontic treatment will take around few months to years.[80] The composite resins is available in different shades therefore if the shade selection is done properly, only the operator and the patient knows about the treatment that has been done to close the space. [79.80,81]

-Restorative treatment ;

Patient demand for aesthetic dentistry with minimally invasive procedures has resulted in the extensive utilization of freehand bonding of composite resin to anterior teeth .[1,2,3,4] Dental patients are more conscious of their appearances and have raised the importance of the smile within society as a whole; this impacts full mouth restoration as well as more conservative restorative procedures that include class IV restorations, veneers and diastema closure.[2] The diastema presents itself to the dental office on a regular basis. It may be small or large. The papilla may be long and skinny or blunted. The size will have an effect on what material will be chosen to achieve the desired results. When dealing with a large space closure, orthodontist may be indicated to allow for a more esthetic outcome.[1,2,3,4,723] When the teeth are in proper orthodontic alignment, no preparation of the tooth structure is necessary. If there is an alignment problem, minor tooth preparation will be necessary to achieve proper arch form. Composite resin is an ideal material when restoring diastema closure. It is highly polishable, long lasting and mimics natural tooth structure. It is a conservative alternative to an indirect restoration. [1,2,3,4,73] It is important

to mention that there are restorative solutions to these cases without orthodontic intervention.[41,53] However, restorative measures are more likely to be appropriate in adults and are also subject to on-going maintenance issues. [72,73]Care must be taken that the emergence profile of any restoration is not over-contoured creatinghygiene problems. Care must also be taken with the crown width/length ratio.[56,58,72,73] Maxillary midline spacing can also be reduced or temporarily closed with composite resin directly on the proximal surfaces of teeth adjacent to the space without bonding agent prior to orthodontics. It may then be removed as tooth movement proceeds. When combined orthodontic-restorative treatment is planned, collaboration between the orthodontist and the restoring dentist should begin at the diagnostic phase.[1,2,3,4,28,73]

F.CASE REPORT

Case .1

The 20-year-old female patient's chief complaint was a small gap between upper central incisors. She had a symmetric face, competent lips and average smile line (Figure 12a). The upper and lower dental

Figure 12.a.Initial intraoral photographs

Figure 12.b.Initial clear tray wear with elastic

Figure 12.c.Four weeks after clear tray wear, before proximal enamel reduction

Figure 12.d.Final intraoral photographs

midlines were coincident with the facial midline. The patient had a slightly increased overjet and normal overbite, and class 1 molar and canine relationships on both sides. The Bolton (9) tooth size analysis showed 1 mm upper anterior excess (Figure12b).

Treatment objectives were to close diastema and maintain class 1 canine/molar relationship bilaterally during treatment. The diastema was small and the patient did not want fixed orthodontic treatment, and initial lateral cephalometric film was not taken.

Therefore, a clear device was fabricated to close the diastema. Informed consent was obtained from the patient. A 0.040-in polyethylene terephthalate copolyester thermoplastic sheet was used to fabricate a tray over the maxillary dental plaster model of the patient's teeth on a vacuum-forming unit (7). The tray was trimmed in the vestibular and lingual surfaces of the teeth, avoiding the gingival margins (Figure 12c). The tray was then sectioned in half in the midline to create separate the right and left trays. Two bondable buttons were then attached to the region corresponding to the center of the vestibular surface of the maxillary canine tooth in each half of the tray. An elastic (1⁄4", 4.5 oz) was then used between these buttons in the vestibular surface (Figures 3, 4). The patient was asked to wear the trays with the elastic full-time except during meals. Diastema was closed after 4 weeks and no remaining space was left (Figure 12c). Mesial surfaces of the upper central incisors were wider in the middle and cervical regions than in the incisal region. The upper central incisors were reshaped by reducing the maxillary central incisors 1 mm mesially from the middle and cervical regions and the patient was asked to continue wear the trays with the elastic. After closure of diastema, upper canine-tocanine fixed lingual retainer was placed for retention.

The total treatment period was 2 months. The final intraoral photographs showed that dental relationship was preserved and diastema was closed .

The final facial photographs displayed an attractive smile with a pleasing smile arc (Figure 12d). The patient was pleased with her teeth and the treatment results.

Case .2

A patient reported to the Department of Orthodontics with the chief complaint of midline spacing in the upper anterior teeth. On extra oral examination the patient had a straight profile and anterior facial divergence with competent lips. Intraoral examination revealed midline spacing of 3mm in relation to 11 and 21with papilla penetrating upper labial frenum, with Angle's class I molar relation on left side and super class I on

right side, Class I canine relation on rightside, end on relat on left side, overjet of 4mm and overbite of 4mm. An anterior Bolton discrepancy of 1.8 mm existed.

Angle's Class I malocclusion on class I skeletal base with midline diastema. (Fig-13a) The treatment objective for this case was to close the mid line spacing maintaining the same molarrelation and canine relationship and build up the lateral incisors.

A non-extraction treatment plan was decided for the case. The upper central incisors were bonded with

brackets. Midline space closure was decided to be done using the 'Trihelix' spring, followed by frenectomy and upper lateral incisor build up for the Bolton's discrepancy of mandibular anterior excess of 1.8mm .This innovative spring is fabricated with A J Wilcock, Stainless steel, 0.014''special plus wire and contains three helices (Fig 13b). One large helix of 3mm diameter is towards the cervical and the two small helices of 2.5mm diameter are towards the incisal. It consists of two arms

with anti-tip bends of 350 bent towards the cervical. The two arms are pulled, forcefully engaged into the incisor brackets and cinched back (Fig 13c).A force of approximately 150gms was produced when engaged in to the brackets.

Fig. 13.a;Pre treatment

Fig. 13.b Trihelix spring

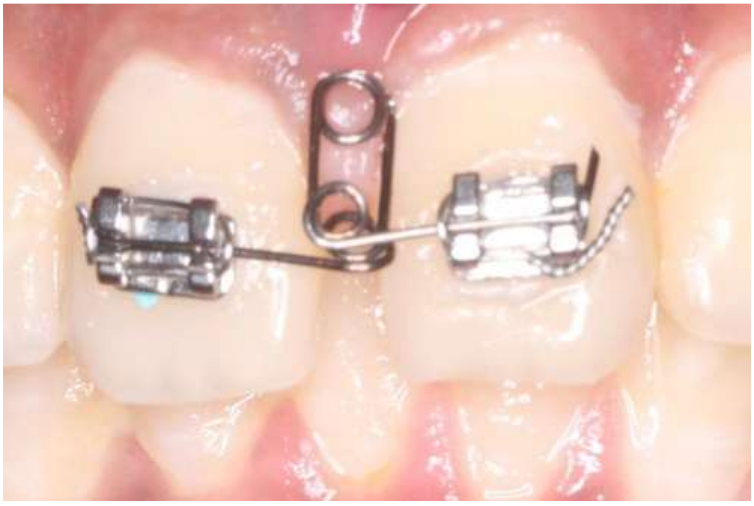

Fig.13.c; 3Trihelix spring

Fig. 13.d;After first activation

Fig. 13.e;. Post diastema closure

A definite 3mm diastema closure (Fig 13d) was achieved in a span of 6 weeks with good parallelism of roots as revealed from pre (Fig 13a) and post (Fig 13e) treatment radiographs.

Case .3

A 9-year, 5-month-old male patient came for a consultation with the chief complaint that he did not like the gap between his maxillary central incisors because it resulted in his

exposure to bullying at school. On examination, the following factors were revealed: class I malocclusion, overjet of 4.0 mm, mild overbite, diastema between the central incisors of 9mm (the mother reported that the extraction of a mesiodens was performed at the age of 8), diastemas between the central and lateral incisors and between the lower incisors, a labial frenulum with a low insertion, and rotation of the

incisors (Figures 14a and 2b). The correct mandibular midline was diagnosed with consideration of the maxillary midline via the “V” cupid bow technique [9]

Radiographically, the correct sequence of eruption, skeletalclass I malocclusion, a sagittal growth trend, and proclination of the maxillary and mandibular incisors were noted (Figure 14b).

The diagnosis and treatment options for minimizing the width of the diastema were explained to the patient, his parents, and the general practitioner who referred the patient.

Treatment Objectives. The goal of the orthodontic treatment was to reduce the size of the diastemas, particularly those

between the maxillary central and left lateral incisors.

At this stage, we sought tomaintain the positions of the upper and lower incisors.

Treatment Alternatives. The following alternatives were explained: (a) a removable appliance with clasps and digital springs positioned distal to the left central incisors and

associatedwitha labial arch,whichwasnot indicatedbecause it would only tip the crown and would not result in body movement; (b) brackets bonded to the maxillary central

incisors to reciprocally move the incisors with elastic chains, which would deviate the midline to the left; and (c) partial fixed appliances with brackets bonded to the incisors and bands on the first permanent molars to move the left central incisor using the teeth on the right side or the archwire as an anchorage point.This latter approach was applied.

Treatment Progress. Orthodontic treatment was initiated with the cementation of the first molar bands and bonding brackets on the maxillary central incisors. The treatment

began with a .016 × .022-in stainless steel arch with a fair loop flush on the mesial side of the right central incisor bracket. (Figures 14 c).

Omega loops were kept tight to the tubes of the molars. An elastic chain connected the flap mesial to the left central incisor to the loop to move the left incisor toward the right

central incisor. After achieving a position similar to the “ugly duckling” stage, the bracket was bonded to the left lateral incisor and moved mesially with elastics.

Treatment Results. The treatment promoted a reduction in the diastema to a size that was similar to the physiological “ugly duckling” phase. The maxillary left central and lateral incisors were moved mesially to a greater extent than the maxillary right central incisor to match the midline. The appliance was removed, and a flat wire segment was bonded into the palatal surfaces of both central incisors with the intention of being maintained until complete eruption of the canines (Figures 14 d).

Figure 14.a;: Pretreatment intraoral photographs

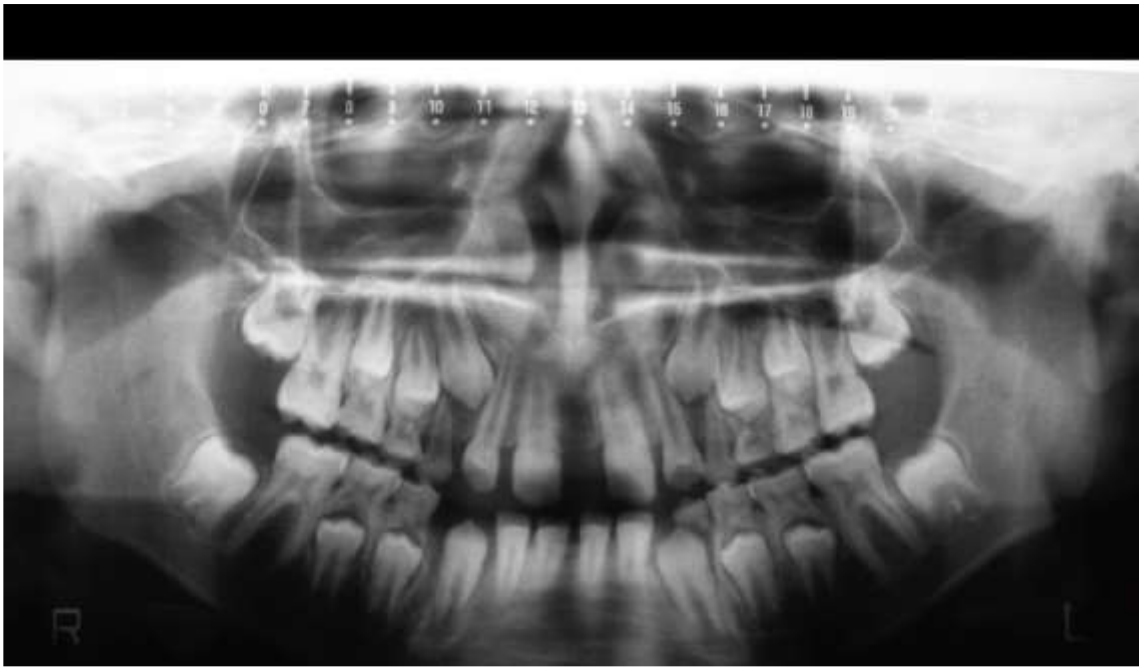

Figure 14.b;: Pretreatment radiographs

Figure 14.c;: Progress. Determination of the correct midline and biomechanics for moving the maxillary right central incisor to the left.

Figure 14.d;4: Posttreatment intraoral photographs

Case .4

A 21-year-old female patient was directed to one of the author's private practices presenting with an MMD after the completion of orthodontic treatment. An exhaustive clinical examination was performed, and the maintenance of orthodontic appliances and diastema between tooth 1.1 and 2.1 were noted. This included morphological and altered tooth proportions in both maxillary central incisors (Figure 15a).

A complete analysis of tooth proportions was performed, and the initial height and width of both upper central incisors was determined.

A therapeutic proposal was developed based on digital treatment planning, which established the ideal proportions for tooth 1.1 and 2.1. A conservative treatment with composite resin was possible, and the patient consented to proceed with the therapeutic approach. Therefore, the removal of the orthodontic appliances for tooth 1.1 and 2.1 was requested in order to execute the treatment.[1,2,3.4]

An initial color test was performed using composite resin masses that would be used to restore both central incisors (Figure15b). Once the color selection was made, it was decided to perform a restorative test. This procedure was done without including any kind of adhesive system such that the correct integration of shape and color matching the restorations could be verified in advance, allowing easy removal of the resins (Figure 15c).[88]

Under relative isolation with a rubber dam, the adhesive technique was performed on tooth 1.1. After the surface was cleaned with pumice, the enamel was etched with 37% phosphoric acid for 30 seconds (Figure 15c), rinsed profusely with water, and the tooth's surface was dried. A thin layer of a two-step etch-and-rinse adhesive was then applied, air-thinned, and light-cured for 20 seconds.[1,2]

Figure 15.a;. Initial situation. Patient presented with orthodontic appliances

Figure 15.b. Restorative test without bonding technique. In this case, it can be appreciate that color match is acceptable, and diastema closure is

Figure 15.b. Restorative test without bonding technique. In this case, it can be appreciate that color match is acceptable, and diastema closure is

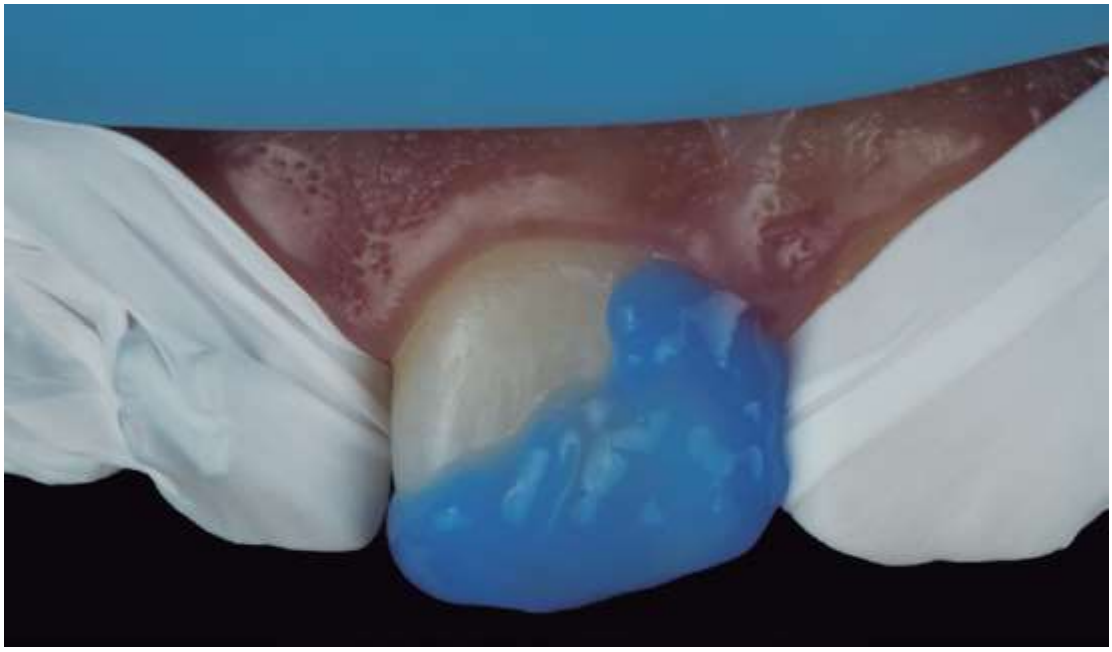

Figure 15.c;. Bonding technique. Under partial isolation, application of bonding procedures are easy to perform. Initial step showing 37%phosphoric acid application in enamel. Neighboring tooth must be protected with teflon tapes

Figure1 5.d; First polishing paste with diamond pastes of 1 micron. The

application must be performed with hair coat wheel brushes.

Figure 15.e;. Immediate control after finishing and polishing procedure.

Figure 15.f;. 10-month control image. Correct color and shape integration can be appreciated.

Once the enamel's surface was conditioned, a high reflective index composite resin was carefully applied using a free-hand technique to restore the proximal and palatal areas of the enamel . This was then light-cured for 40 seconds.
At this point, the clinician left enough space for the incorporation of a small amount of opalescent resin in the incisal and the enamel for the vestibular aspect of the tooth
After the restoration of tooth 1.1 was complete, the restoration of tooth2.1 proceeded using the same approach. The clinician used small mylar strips during polymerization of the proximal composite resin layer in order to prevent bonding between both restorations.[1,2,3,73,76,77,78]
The finishing and polishing procedure initially began with shaping the macro-morphology of the incisors using medium-sized aluminum oxide grit discs . The vertical micro-anatomy was crafted using multi-laminated carbide burs. Horizontal micro-anatomy was not performed in this case because the patient had no clear microtexture
marked by periquematis. Finally, the polishing procedure was carried out using diamond and aluminum oxide three-step pastes(Figure15d). The first 3-µm and 1-µm diamond pastes were applied sequentially with goat hair brushes , and then

the aluminum oxide paste was applied with cotton felt . Between each step, the clinician tried to clean the tooth surface with a gauze soaked in alcohol to eliminate oils contained in the polishing pastes. (Figure15e)
Images of immediate control and the final outcome with a 10-month control are shown in Figure15f , respectively.

Case .5

A 22 years old woman came to our Dental Clinic with a chief complaint of shyness and lack of confidence due to some white spot and gap on the two central front teeth. The patient´s medical history did not reveal any systemic diseases. The clinical examination showed white spot lesions on tooth 11 21 and central diastema between 11 21 (Figure.16a). All anterior teeth, as well as the surrounding soft tissues were immaculate and helathy. The decision was made to improve his smile with a conservative, direct adhesive procedure using resin composite.

All of the treatment were done in one visit, anamnesis, clinical examination, thorough explanation, and initial study to understand about patient's consent in esthetic treatment procedure were done. First, rubber dam was placed to achieve an asepsis area. Blue color sheet was chosen in order to give a contrast color to make it easier in choosing color and doing the multi-layering technique (Figure 16b).
After rubber dam was placed, composite shades taking was done by using button shade technique. It was done on lateral incisive. Mass of dentin color was placed on cervical area and mass of enamel color was placed on incisal area then light cured. Micerium UD3 color was chosen for dentin shade and micerium UE2 was chosen for enamel shade (Figure16c). Minimal invasive preparation was done to remove all of the white spot. Bevelling was done to give a better retention of composites and to help blending the color better at the border between the real tooth and the restoration (Figure 16d).

Figure 16.a;. Preoperative look: White spot on tooth 11 and 21 and central diastema

Figure 16.b;. Rubber dam placement to achieve an asepsis area.

Figure 16.c;;. Preparation of the teeth

Figure .16.d; Total etch procedure

Teflon tape was placed at the lateral incisive to protect lateral teeth from the etch. Total etch technique was done by using 37% phosphoric acid for 30s on enamel and 15s on dentin, then rinsed with water spray and dried (Figure 16d).

Thin layer of prime&bond one ETCH & RINSE was applied with rubbing motion on the surface and then dried with compressed air until there was no movement from the bonding and then light cured . Dentin part was layered using UD3 Micerium dentin color. Mamelon was made and then light cured (Figure16e).

Final layering for enamel and diastema closure were done using Micerium UE2 Enamel color then light cured. Sectional matrix were placed vertically to make the proximal contour of the restorations (Figure16f). The finishing was done using abrasive disc and lastly, the restorations were then polished with lowspeed handpiece and Enhance PoGo® systems (Figure16g and 16h).

Figure1 6.e; Bonding procedure

Figure 16.f;. Dentin layering

Figure 16.g;. Finishing and polishing

Figure 16.h;. Final result, the restoration color managed to blend naturally and the central diastema already closed.

Case .6

A 32-year-old male patient reported to our Dental Clinic , with the chief complaint of spacing in the upper fronttooth region. Patient's medical history did not reveal any systemic diseases and intraoral examination revealed presence of midline spacing between maxillary central incisors (4 mm) due to tongue thrust parafunction (Figure.17a).No dental carieswere observed in both clinical and radiographical examinations.

As a more conservative, economical, aesthetic, and quicker option, direct aesthetic partial composite laminate veneers as build-ups for both maxillary central incisors were considered.

Firstly, shade selection was considered A1 shade of Vita guide for the teeth to be restored. In order to simulate a natural A1 shade outlook, the shades BW, A1, and JE were decided to be used together as layers. No preparations were performed before the restoration procedure (Figure 17b).All maxillary incisorswere isolated with rubber dam and the central incisors were retracted by using retraction cord .The adjacent central incisor was covered with Teflon band while the other was restored. 37% phosphoric acid was applied on the mesial surface to be restored for 15 seconds, rinsed for 20 seconds, and dried with air slightly. Figure 17c)Then a single bottle bonding agent was applied and polymerized for 20 seconds with a LED light generator . A thin layer of JE shade transparent composite resin was used palatinally as enamel (Figure 17d). A thin layer of BW shade opaque composite resin was placed roughly as second layer . A1 shade composite resin was used as dentin layer and a thin layer JE shade was used as the top enamel layer. Labial surfaces of the restorationswere flattened by using a red banded knife-edge tip diamond bur . (Figure 17e). Polishing discs were used for detailed polishing from rough to fine grains by using a low speed handpiece The patient was motivated for oral hygiene and informed for recalls. At the 6-month recall the restorations were just polished with polishing discs. At one-year recall nosensitivities, discolorations, or fractures were detected on the teeth and the restorations (Figure 17f).

Figure 17 a: Preoperative extraoral view of the patient with aesthetic

problems due to the tongue thrust

Figure 17.b: Preoperative intraoral view of the patient and themidline Diastema

Figure 17c:Theadjacent central incisor was covered with Teflon band while the other was restored. A thin layer of JE shade transparent composite resin was used palatinally as enamel.

Figure 17d: A1 shade composite resin was used as dentin layer and a thin layer of JE shade was used as the top enamel layer. Labial surfaces of the restorations were flattened by using a red banded knife-edge tip diamond bur.

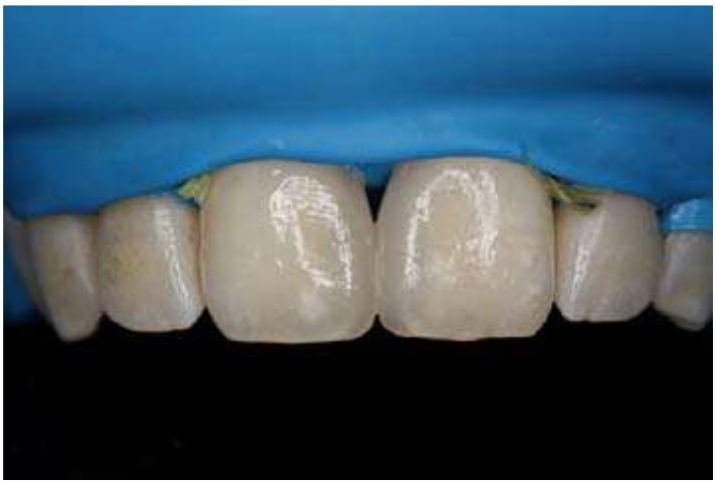

Figure17.e : Polishing discs were used for detailed polishing from

rough to fine grit.

Figure 17f: Postoperative view of the restorations just after removal

of the rubber dam and the retraction cords.

Case.7

A 42-year-old woman visited to my private dental clinic, with a chief complaint of "desire to improve esthetics" because of the existing space between anterior maxillary teeth. The patient had uneven space between anterior maxillary teeth and showed deep bite Angle class II malocclusion. The problem list of patient's anterior maxillary part was as followed: asymmetrical zenith lines, abnormal incisal profile with disharmonious tooth axes and imbalances in tooth positions The midline was deviated and the maxilla was canted to the right. The proportion of tooth size was asymmetrical and there was wide diastema between central incisors, approximately 2 mm [Fig.18a]. On the first visit, irreversible hydrocolloid impressions of both maxillary and mandibular arches were taken, and diagnostic wax up was performed. To produce the most esthetic result, recurring esthetic dental (RED) proportion was used to establish the widths of the anterior six teeth as viewed from the frontal. The author has defined the RED proportion as the proportion of successive widths of the teeth viewed from the frontal, remaining constant as one moves distally. As it is well known, the golden proportion is limited to 62%, however, the RED proportion gives greater flexibility, as the dentist can define desired RED proportion, and an

approximate 70% is preferred. Based on the RED proportion of 70%, diagnostic wax-up was performed, and the favorable results were predicted by space redistribution. If the right central incisor would be moved toward mesial and incisal directions 1 mm.
Deciding as for the treatment option, the MBT brackets respectively, the left lateral incisor would be moved toward incisal direction 1 mm. [8][Fig.18b]were bonded to the anterior maxillary teeth according to their related positions, and the brackets of the right central incisor and the left lateral incisor were bonded in slightly cervical positions for extrusion .Then open coil spring was inserted between the right central incisor and the right lateral incisor in order to move the right central incisor in mesial direction. On the other hand, closed coil springs were inserted between the right central incisor and the left central incisor and between the right lateral incisor and the right canine, with keeping in mind not to overclose of the diastema and not to take the wrong distal direction for the right lateral incisor.

Fig.18.a;Pretreatment intra-oral photograph.

After the spring and wire were inserted, all of the brackets and 016 stainless-steel round wire were ligated tightly and activation of teeth movements had begun The recall checks were carried out with two weeks intervals. The careful observation of teeth movements was fulfilled and open coil spring had been changed, if necessary. [Fig.18c]

Fig.18.b; The brackets were bonded as considered the teeth movements

The occlusal adjustment of extruded right central incisor and the palatal surface of the left lateral incisor was carried out to remove occlusal interferences. The minute examination was performed for evaluating favorable teeth movements 6

weeks after brackets bonding procedure. Because the teeth were in proper positions in the maxillary dentition, all brackets and wire were removed, and the teeth surfaces were cleaned and polished. The fixed retainer was bonded to avoid the relapse of the moved teeth.

Fig.18.c; Porcelain laminate veneer preparation

On the next visit, porcelain laminate preparation was performed with the silicone index attained from the diagnostic wax-up cast. Immediate dentin sealing was carried out for achieving improved bond strength, fewer gap formations, decreasing bacterial leakage, and reducing dentin sensitivity.The final impression was taken with polyvinyl siloxane impression material using 1-step technique. Shade was carefully decided considering the prepared teeth and opposite mandibular incisors with shade guide . The provisional restorations were fabricated directly with premade silicone index attained from the diagnostic wax-up cast .

Fig 18.d; Veneer restorations for maxillary lateral and central incisors on master model. The palatal aspect demonstrates wrapped preparation design.

After 2 weeks, the final restorations was completed and tried in the mouth, all margins, contacts were verified. The final restorations were bonded using resin cement . After delivery, as shown in , the gingiva was healthy and showed harmonious shapes and contours. The proper esthetics was obtained that the shade of surrounding tissues was stable and shown balanced properties, the proportion of tooth size was favorable and satisfied . [Fig.18d]

The retainer was bonded for maximum retention of new teeth positions. The following check-ups of the patient were performed for 3 months after placement of the definitive prosthesis, and oral hygien was maintained in excellent state and tooth alignment was stable. The patient was very satisfied with the appearance and the function.[Fig.18e]

Fig 18e; Frontal view of definitive porcelain laminate veneers

Case .8

The patient, male, aged 20 years, attended the our Dental Clinics complaining about his smile appearance(. At clinical examination, it was observed that the patient presented diastemas among the maxillary and mandibular anterior teeth, with misalignment of long axes and incisal edges of the incisors, and teeth #14, #15, #24, and #25 showing axial inclination towards palatal direction.[Fig.19a].
After clinical examination and case study, it was verified that the correction of the deficiencies that provide the esthetic impairment of the smile could be achieve through "contact lenses" on the teeth #11, #12, #14, #15, #21, #22, #24, and #25 associated
with ceramic fragments on teeth #13 and #23, without tooth structure weariness. To close the mandibular diastemas, resin composite restoration was chosen.
The impressions of the maxillary and mandibular arches were obtained with the aid of irreversible hydrocolloid to obtain dental casts that were used to construct bleaching trays and diagnostic wax-up .
Following, the patient was submitted to tooth scaling through ultrasound, tooth polishing with the aid of prophylatic paste and rubber cups, and the register of initial tooth color (shade A3).
The home-bleaching technique was used with the aid of 10% carbamide peroxide for 21 days. The patient was instructed to use both the maxillary and mandibular trays all night long and avoid intake of food with pigments. After tooth bleaching procedure, the final color of the teeth was shade A1 . .[Fig.19b].

Figure 1 – Fig.19.a;Frontal view of the initial condition of teeth

Figure 19b;Color register after bleaching

On the study cast with the wax-up, a matrix was constructed with the aid of o condensation silicone , for mock-up purpose. The mock-up was performed with bisacrylic resin inserted inside the matrix and placed on the labial surface of the teeth to be restored The restorative mock-up enabled that the patient predicted the final aspect of his smile .

To obtain the working cast, an impression of the maxillary arch was obtained with condensation silicone . The cast was duplicated in refractory cast for ceramic stratification of the "contact lenses" . .[Fig.19ac].

Fi Fig.19c; Tooth aspect after mock-up

Fig.19d;Aspect ofontact lenses and porcelain Fracments

After the adaptation of the laminates on the teeth, their labial surfaces were etched with 35% phosphoric acid for 30 seconds, followed by copious washing and drying with absorbent paper. Next, the bonding agent was applied and light-cured for 20
seconds). The color of the cement was selected after the test through the system provided by the cement's manufact. The internal surfaces of the contact lenses were etched with 15% hydrof luoric acid for 5 minutes, followed by the application of silane agent for 1 minute. .[Fig.19d].
The resin cement was inserted inside the internal part of contact lenses , which were placed onto the tooth surfaces. The excesses of resin cement were removed. The cement was lightcured for 40 seconds, on every contact lens. The polishing procedure of the margins was carried out through ceramic polishers.
After the cementation of the laminates on the maxillary teeth , the mandibular teeth were restored with resin composite to close the diastemas among the incisors, following the procedures for adhesive restorations. .[Fig.19e].

Figure1 9e – View of the smile after cementation of contact lenses

Case .9

A 21 years female was referred to our dental clinics,with chief complaint of spacing in upper anterior teeth. Diastema was observed in upper anterior teeth & preoperative photograph was taken. It was emphasized that all treatment considerations (including no treatment) were studied before restoring immediately to composite augmentation. Line drawings, photographs, computer imaging, models

with spaces filled & or direct temporary additions of wax & composite uncured material on the natural unetched teeth were done as preliminary procedures. No relevant medical history was found. .[Fig.20.1.2.3].

Fig20.1: Straight on

Fig20.2: Left view

Fig20.3: Right view

Fig20.4: Mesial 1/3 of #8 lightly roughened wih a coarse diamond. Greater Curve in place. Matrix is subgingival and exposing subginginival enamel

Fig20.5: The unfilled resin wets the surface and allows the flowable to knife edge against the matrix and tooth. The COMPOSITE is pushed into the unfilled resin flowable mixture. All composite cured at one time.

Fig20.6: Composite after band removed. I desire to have excess compsite to shape. Gives me ample composite to shape so 1) I can control the emergence contour, (2) get the midline parrallel to the long axis of the face, and 3) adjust so 8&9 will have the same width

Fig20.7: #8 completed

Fig20.8:Before I bond #9 I quickly place unbonded composite on the mesial of #9 to see if I have the width and midline correct. Takes seconds to do. This way you know it will look right

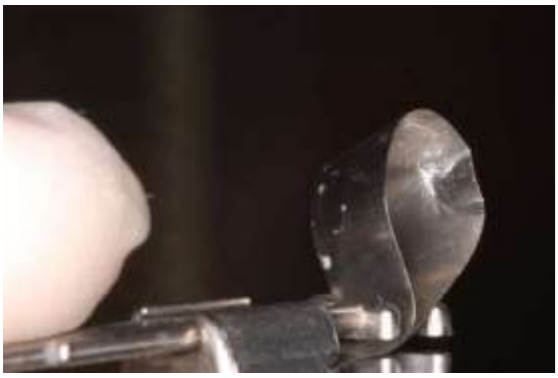

Fig20.9:Greater Curve around #9 and marked the contact point with an explorer.

Fig20.10: Contact cut away with a small football finishing carbide.

Fig20.11:Matrix placed. Teflon tape placed. (Teflon tape optional. I place it when I can do it quickly.) Seqence of composite placement the same

Fig20.12: For tooth #10 the space was too large for the Greater Curve to traverse. To get the matrix to warp further, a slot was cut at the distal, and the retainer was rotated into the tooth. Rotating the matrix makes the mesial portion of the band flare more toward the distal of #9.

Fig20.13: Straight on view after Diastema Closure. (I rounded the mesial corner of #8 before the patient was excused.

Fig20.14: Right side

Fig20.15:Left side. Also bonded mesial # 12.

The correction of a diastema between teeth is described. After the teeth were cleaned and the shade selected, the proximal surfaces were observed starting with midline. We assumed that incisors were of equal size, symmetrical additions can be ensured by using half of the total measurement of the diastema. Cotton rolls. All restorations began below the gingival crest to appear natural and to be confluent with tooth contours.

The retraction cord (# "00") was inserted for One The correction of a diastema between teeth is described. After the teeth were cleaned and the shade selected, the proximal surfaces were observed starting with midline. We assumed that incisors were of equal size, symmetrical additions can be ensured by using half of the total measurement of the diastema. Cotton rolls, instead of rubber dam were recommended for isolation because of importance of relating the contour of the restoration directly to the proximal surfaces. All restorations began below the gingival crest to appear natural and to be confluent with tooth contours.

The retraction cord (# "00") was inserted for one tooth at a time to prevent seepage from the crevice. To enhance retention of composite, a flat end tapering fissure diamond bur was used to roughen the proximal surfaces extending from the facial line angle to lingual line angle. More extension was needed to correct facial & lingual contours, depending on the anatomy & position of individualtooth. A gel etchant (37% phosphoric acid; Ivoclar Vivadent, Schann, Liechtenstein) was then applied with a syringe to prepared surface, approximately 0.5 mm beyond the cavo-surface margins onto unprepared tooth. .[Fig.20.4].

The acid was rinsed & air dried to achieve a frosty matt appearance. A 2x2 inch gauze was draped across the mouth & tongue to prevent in advertent contamination of the etched preparations by the patient. In our case wedge could not be used. The celluloid strip (Mylar matrix strip) was held on the lingual aspect of tooth to be restored with index finger while facial end was reflected for access. After the bonding agent(Excite, Dimethacrylate, alcohol, phisphonic acid acrylate, HEMA, SiO , initiators, stabilizers, Batch#63821, Ivoclar 2Vivadent, Schaan, Liechtenstein) application & light curing for 20 seconds Nanofill composite material was inserted with Teflon coated hand instrument (Dentsply) to ensure confluence with the

lingual surface. The matrix (Mylar matrix strip) was then gently closed facially beginning with the gingival aspect. Care was taken not to pull the strip too tightly, to prevent under contouring of restoration. light curing system was used . .[Fig.20.5,6].

The curing of material was done from labial & lingual sides for minimum of 20 seconds for a total 40 seconds. It was initially over contoured in order to facilitate finishing to an ideal contour. After completion of polymerization the celluloid strip was removed. Contouring & finishing were achieved with appropriate flame shaped carbide finishing burs or abrasive finishing strips & discs by shofu (Shofu dental corporation, Sanmarcosca, USA). Final polishing was differed until completion of the contra lateral restoration. Overhangs must not be present. Removal of the gingival retraction cord facilitated inspection & smoothing of gingival area. If there is no fraying of floss it verifies that the gingival margin is correct & smooth. It was important for first restoration to establish correct mesiodistal dimension before starting second restoration. After etching, rinsing, drying & bonding application the next teeth were restored & similarly all teeth were restored one by one .[Fig.20.7,8,9,10,11,12] A tight proximal contour was achieved by displacing the second tooth in distal directionwith holding matrix with thumb & index finger. Contouring was given by carbide bur & finishing cups (Astropol, Ivoclar, Vivadent). Again unwaxed floss was used to detect any excess material or overhang.

A silicon carbide brush can also be used . The final polish is accomplished with a soft goat-hair brush and fluffy cloth wheel mop with diamond finishing paste. .[Fig.20. 13,14,15].

G.Retention of the result and prognosis;

Relapse of the maxillary midline diastema appears, according to Sullivan et al. (1996),30 in almost 34% of cases, while ,according to Shashua and Artun (1999) this rate rises to50%.[89] The reason for relapse is the placement of teeth in a position where no equilibrium exists with their functional environment. In most of these cases, the factor disturbing this equilibrium is still present after treatment .[49]Shashua and Artun (1999) concluded that the most important risk factors for relapse are the increased pretreatment width of the midline diastema, the presence of a family member with a similar condition, and the presence of more than one diastemas in the maxillary anterior region .[49] Fig.21However, according to Sullivan et al. (1996), no pre-treatment predictors of relapse can be established. As a general rule, treatment is unlikely to produce assured and stable results, thus the use of permanent retention for a considerable period of time or even for life, is essential in almost every case. [89]The most appropriate method for achieving long-term retention after orthodontic treatment is through the use of palatally bonded multi-stranded stainless steel wire retainers, which allow teeth to maintain their physiologic mobility and are easy to fabri-cate.[51,90] In cases where the retainer interferes in functional movements of the mandible, it can be bonded cervically or within a shallow rim constructed in the enamel of teeth.[91,92]

Fig.21.Bonded retainer placed on the palatal surfaces of the permanent maxillary central incisor teeth to retain the orthodontic closure of a pre-treatment median diastema.

2. CONCLUSION:

The treatment of diastema either by orthodontics, restorative dentistry, periodontology or a combination of these disciplines should be focused on the aetiological factors, patient needs, aesthetics and stable results. Identification of the aetiological factors and consideration of the dentofacial characteristics of the patient are essential for the appropriate therapy. Following diagnosis and individualised treatment planning, satisfactory treatment outcomes can be achieved with different orthodontic mechanics and approaches. . However, when the diastema is larger than 2.7 mm even after the eruption of lateral incisors, orthodontic intervention may be necessary. Timing often is significant to achieve satisfactory results. Several etiological factors are conveyed and debated in literature, and no single etiological factor is decided upon for the development of a midline diastema. Tooth movement usually is postponed until the eruption of the permanent canines, but can begin premature in certain cases with very large diastemas. Retention procedure should be subject to the size and the etiology of the midline diastema. This chapter will present management of spacing with orthodontics alone or as a part of interdisciplinary treatment depending on the causative factors.

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