Chapter 7

Orthodontics and Oral, Dental, and Maxillofacial Surgery: Multidisciplinary Treatment and Current Approaches

Ali Kağan Özen[1]

Abstract

This book chapter comprehensively addresses multidisciplinary treatment approaches between orthodontics and oral, dental, and maxillofacial surgery. In individuals with cleft lip and palate, orthodontic treatment before, during, and after the surgical process constitutes one of the cornerstones of treatment success when correcting skeletal jaw anomalies surgically. Additionally, the integration of impacted teeth into the oral cavity is only possible through coordinated planning of surgical exposure and orthodontic traction. In cases of severe maxillofacial deficiencies, gradual expansion of the jawbones is achieved through distraction osteogenesis; in this process, orthodontic treatment plays a critical role in ensuring harmony at both skeletal and dental levels. When these approaches are combined with individualized planning, interdisciplinary collaboration, and accurate timing, it becomes possible to achieve both functional and aesthetic success.

Orthodontics is essentially a branch of science that aims to ensure the hard and soft tissues in the jaw and facial region remain within normal growth and developmental limits. To achieve this goal, collaboration with both medical and dental specialties is often necessary. At the forefront of these specialties is oral and maxillofacial surgery. The main objectives of this collaboration include expanding the physical limits of orthodontic treatment, accelerating treatment, facilitating trauma rehabilitation, preventing or reducing orthodontic relapse, and most commonly, making treatment possible in cases involving impacted teeth. This section aims to explain the relationship between orthodontics and oral, dental, and maxillofacial surgery in line with these objectives.

1 Asst. Prof. Dr., Kafkas University Faculty of Dentistry, Department of Orthodontics, ali-kagan@gmail.com, ORCID ID: 0000-0002-8729-0914

https://doi.org/10.58830/ozgur.pub733.c3059

1. Impacted Teeth

In both general dentistry and orthodontics, the timely eruption of teeth within the expected age range is an important criterion for predicting orthodontic anomalies early on. While chronological or skeletal age can be indicative, the stage of root development is actually more decisive in determining a tooth's eruption status. It is known that a tooth beginning to erupt has typically reached about three-quarters of its final root length (Grøn, 1962). After third molars, the most commonly impacted teeth are canines. According to one assessment, a canine is considered impacted if its root development is complete and its counterpart on the opposite side has erupted at least six months earlier (Aydin et al., 2004; Dachi & Howell, 1961; Lindauer et al., 1992; Thilander & Myrberg, 1973).

Knowing the criteria that define an impacted tooth is crucial to determine the right timing and method for surgical intervention. Even if a tooth doesn't yet meet these criteria, the presence of obstacles like persistent deciduous/supernumerary teeth or pathological formations such as tumors or cysts may pose a future risk of impaction and require early surgical management (Demirel et al., 2019; Hankinson et al., 2024; Mitchell & Bennett, 1992). When such obstructions are surgically removed, the tooth often erupts on its own. If not, orthodontic force can be applied to guide the eruption.

When maxillary incisors are impacted, there are four main techniques to expose them: simple excision (gingivectomy), apically positioned flap (APF), closed eruption technique, surgical replantation (Kokich & Mathews, 2014). For impacted canines, gingivectomy, APF, and the closed eruption method are commonly used. Gingivectomy and APF are classified as open eruption methods (Chaushu et al., 2003). Gingivectomy should only be performed if at least 3 mm of gum tissue remains around the tooth post-procedure. However, since anterior impacted teeth are typically located at or above the mucogingival junction, gingivectomy is often unsuitable and may result in thick, apically positioned, rounded, and anaesthetic gum tissue over the crown. To counter this, the apically positioned flap technique is recommended to ensure a band of keratinized gingiva on the labial side (Vanarsdall & Corn, 1977). However, APF can result in a more apical gingival margin, longer clinical crown, greater attachment and bone loss compared to the closed eruption method (Vermette et al., 1995). Moreover, in terms of recurrence after a certain period of time, re-intrusion is also experienced.

In the closed eruption technique, a flap is raised over the impacted tooth, an orthodontic attachment is bonded to the crown, and the tooth is guided into eruption along the alveolar ridge. This technique's advantages are that it avoids open wounds and dressings, allows alignment during eruption, reduces scarring and periodontal issues, and preserves attached gingiva (Crescini et al., 1994; Sherwood, 2013; Vermette et al., 1995). It is the most common method used for impacted central incisors (Sfeir et al., 2018). Furthermore, Sfeir et al. also note that waiting a while before applying force post-exposure helps supracrestal fibers properly attach to the cementum.

The surgical replantation technique is an option for teeth that are horizontally or inverted vertically positioned within the bone. After flap elevation, the tooth follicle is enucleated and placed in a surgically prepared osteotomy site, ideally just below the occlusal level (Kokich & Mathews, 2014). If root development is still early, this technique may allow the tooth to erupt naturally and complete root formation without orthodontic force (Kuroe et al., 2006). It also provides a way to preserve teeth with root dilacerations that might otherwise need extraction (Tsai, 2002).

2. Orthognathic surgery

Orthognathic surgery refers to the combined orthodontic and surgical treatments aimed at correcting skeletal anomalies in the craniofacial region to restore proper anatomical and functional relationships (Pahkala & Kellokoski, 2007). This type of treatment is typically pursued for individuals with significant jaw deformities, temporomandibular joint disorders, speech problems, chewing inefficiencies, airway issues, or aesthetic concerns (Elsalanty et al., 2007).

While orthodontic treatment can make limited corrections to occlusion, it cannot alter facial aesthetics (Sugawara, 1990). Therefore, cases involving maxillary retrognathia, mandibular prognathism, or combinations of the two may require orthognathic treatment (Athanasiou, 1993; Thilander, 1979). Although bilateral sagittal split osteotomy and Le Fort I osteotomy are the most commonly used techniques today (Proffit et al., 2006), many surgical methods exist for correcting dentofacial deformities. These include: Maxillary Techniques (Surgically Assisted Maxillary Expansion (SARME), Anterior and Posterior Segmental Osteotomies, Le Fort I, II, and III Osteotomies; Mandibular Ramus Techniques (Sagittal Split Ramus Osteotomy, Intraoral Vertical Ramus Osteotomy, Reverse L Osteotomy; Mandibular Corpus Techniques (Anterior Mandibular Subapical Osteotomy (Segmental), Total Subapical Osteotomy, Mandibular Body Surgery (Ostectomy); Genioplasties (Buhara, 2013).

Orthognathic treatments not only correct anomalies but also enhance facial appearance, enabling individuals to be more confident and engaged in daily life.

Some of the above-mentioned surgical methods used in orthognathic treatments are given below.

2.1. Surgically Assisted Maxillary Expansion (SARME)

One of the primary issues affecting the maxilla is transverse maxillary deficiency. Patients with this condition usually present with a narrow palatal arch and often a posterior cross bite (Proffit et al., 2006). The most common treatment to correct this is maxillary expansion (Haas, 1961).

The first maxillary expansion appliance was introduced to the scientific world by Angell in 1860 (Angell, 1860). The modern version of Rapid Maxillary Expansion (RME) was developed by Haas, who created an appliance that bears his name (Haas, 1961). Haas's appliance used both dental anchorage (via bands) and soft tissue support (via an acrylic base). However, due to hygiene difficulties with the acrylic base, Biederman later developed the Hyrax expander, which removed the acrylic base and was more hygienic and thus more clinically preferred (Biederman, 1973). All of the above-mentioned RME techniques can produce skeletal changes in individuals who haven't completed pubertal growth, particularly those whose mid-palatal suture is not yet fully fused. However, in adults, due to the fusion of the suture, these appliances only provide dental changes, with limited or no skeletal effect. To overcome this limitation, Surgically Assisted Rapid Maxillary Expansion (SARME) is used in adult patients. SARME allows for both skeletal and dental changes (Betts, 2016; Woods et al., 1997). With the surgically assisted widening method used, maxillary transversal stenosis cases can be solved by creating both skeletal and dental effects in adult individuals.

In order to perform this procedure, the orthodontist applies the expansion appliance to the patient's mouth before the surgical procedure. After the orthodontist applies the appliance to the patient's mouth, the patient is referred to a musculofascial surgeon and the surgeon performs an incision approximately 5 mm above the horizontal mucogingival junction extending from the first molar to the first molar on the other side. The piriform aperture (apertura priformis), infraorbital nerve and vascular structures and zygomatic process are made visible and a tunnel for dissection is obtained in the pterygomaxillary suture area (Betts, 2016). After this procedure, maxillary release is achieved. Some maxillofacial surgeons, in addition to these procedures, intervene in the palatine suture median and help the expansion process to progress more easily. Classical expansion protocols are applied after the surgery. The patient's recovery period and the treatment period progress in parallel.

2.2. Le Fort I Osteotomy

Le Fort I osteotomy is one of the most frequently used surgical techniques for correcting skeletal deformities in the midface region. It allows the maxilla to be repositioned both aesthetically and functionally. This technique enables movement of the maxilla in three planes (Buchanan & Hyman, 2013); moreover, the maxilla can be moved as a single piece or segmented in both vertical and horizontal planes. The main objective is to separate the maxillary segment that carries the teeth from its connection with the upper maxillary structures. The separated segment must always include the bony palate structure; this is crucial for surgical stability and function (Buchanan & Hyman, 2013; Miloro et al., 2004).

The first Le Fort I osteotomy was performed by von Langenbeck in 1859 to excise nasopharyngeal polyps (Langenbeck, 1859). However, the first true Le Fort I-type maxillary surgery is reported to have been carried out in 1868 by the American surgeon David Williams Cheever (1831–1915) at Boston City Hospital. This procedure is also noted to have been applied to the nasopharyngeal region (Cheever, 1870).

Today, Le Fort I osteotomy is widely used in the treatment of skeletal Class II and Class III malocclusions, maxillary hypoplasia, open bite, and jaw asymmetries (Bell, 1975). This surgical procedure allows for advancement, retraction, inferior repositioning, or superior repositioning of the maxilla. In some patients with asymmetry, these procedures can be done asymmetrically to achieve a more aesthetic appearance.

During the procedure, incisions are made to carefully expose the anterior, lateral, and pterygomaxillary regions of the maxilla. These incisions are typically performed horizontally through the buccolabial mucoperiosteal tissue, parallel to the free gingival margin and above the root apices of the maxillary teeth. The vestibular incision, often extending from the first molar to the opposite molar, can be performed using a scalpel or electro-cautery, depending on the surgeon's preference (Buchanan & Hyman, 2013; Miloro et al., 2004). The osteotomy cut is made approximately 15 mm above the gingival margin and extends forward to the edge of the piriform fossa, passing behind the pterygomaxillary fissure, to avoid the roots of the teeth.

Modifications can be made depending on the specific surgical procedure (Harris & Hunt, 2008).

Le Fort I osteotomy is not only aimed at reshaping the anatomical structure but also constitutes a comprehensive approach that enhances both facial aesthetics and oral functions, making it one of the most preferred procedures for the maxilla in orthognathic surgery.

2.3. Le Fort II Osteotomy

Le Fort II osteotomy is an advanced surgical technique preferred for the aesthetic and functional treatment of various developmental disorders caused by midface hypoplasia. It is especially chosen in cases with flattening or volume loss in the infraorbital region. Compared to Le Fort III osteotomy, Le Fort II has a more limited area of intervention, which makes the surgical procedure less traumatic, and therefore, it is preferred over Le Fort III in selected cases. During the surgical procedure, the maxilla, nasal structures, and a significant portion of the nasal septum are advanced together and rotated along a specific axis to achieve repositioning. This technique aims to increase the anterior projection of the midface and create a more balanced facial contour (Harris & Hunt, 2008).

Access to the surgical site is meticulously ensured by taking into account the frontal and orbital anatomical boundaries. During the mobilization of the anterior segment, careful dissection is performed to avoid damage to the orbital structures, nasal surrounding tissues, and the nasolacrimal system. The target area is exposed by gently elevating the mucoperiosteal layers through horizontal vestibular incisions. Although Le Fort II osteotomy allows for limited repositioning of the maxilla, it is still an effective technique that enables significant aesthetic and functional improvement in the soft tissues and contour profile of the face (Harris & Hunt, 2008).

2.4. Le Fort III Osteotomy

Le Fort III osteotomy is an advanced surgical approach performed in complex cases involving severe maxillofacial hypoplasia and/or craniofacial anomalies. In this procedure, not only the maxilla but also the zygomatic bones, nasal structures, and orbital complex are mobilized together, allowing for a comprehensive forward repositioning of the midface skeleton. Structures such as the globe (eyeball), optic nerve, nasolacrimal duct, and surrounding soft tissues are among the most critical areas that must be protected during the operation. When performed with the Kufner modification, a more balanced and predictable segment movement can be achieved compared to classical methods (Harris & Hunt, 2008).

The osteotomy lines are carefully created to pass through the zygomatic arch, orbital rim, and the frontomaxillary junction. The dissection is performed with high precision to avoid damage to surrounding tissues, and the bone segment is moved forward in a controlled manner using retractors. When necessary, cortico spongious bone grafts are applied to provide structural support. After the osteotomy, stabilization is achieved using miniplates, ensuring successful outcomes both aesthetically and functionally. This technique offers the surgeon a powerful and effective three-dimensional correction tool, especially in cases involving congenital dysmorphisms, severe midface collapse, and complex facial deformities (Harris & Hunt, 2008).

2.5. Anterior Mandibular Corpus Osteotomy

This procedure is typically performed using vestibular incisions made in the first and second premolar region. It may be preferred in Class III anomalies where mandibular prognathism is present, provided there is functional occlusion in the posterior region and/or an anterior open bite is present or absent (Böckmann et al., 2014).

2.6. Posterior Mandibular Corpus Osteotomy

This technique is applied to correct Class III deformities and crossbites in cases where there are missing teeth in the posterior region of the mandible. During the surgical procedure, great care must be taken to protect the neurovascular bundle (Böckmann et al., 2014; Malik, 2012).

In segmental osteotomies performed in the mandible, the mental foramen is used as a reference point. If the incision is made in front of the foramen, it is called an anterior corpus osteotomy; if behind, it is a posterior corpus osteotomy (Malik, 2012).

2.7. Genioplasty

This technique can be performed alone or in combination with other maxillary and/or mandibular osteotomies. Its primary goal is to correct aesthetic concerns related to the chin area. This osteotomy allows movement in three directions, and it can be planned either transversely or vertically.

2.8. Bilateral Sagittal Split Osteotomy (BSSO)

This technique was first developed by Obwegeser and Trauner. One of the biggest reasons it's so commonly preferred is that it is performed intraorally without touching the posterior border of the ramus, which means it doesn't leave visible scars. With bilateral sagittal split osteotomy, the mandible can be moved forward or backward, and asymmetrical corrections and rotational movements can also be performed (Böckmann et al., 2014; Obwegeser, 2007). While it is preferred in mandibular anomalies, the large areas in the incision area and the lack of the need for grafts in mandibular advancement procedures have been effective in the increase in its popularity (Obwegeser, 2007; Pont, 1961).

One of its biggest advantages is that the distal segment is freed up and allowed to move easily. The wide contact surface between the osteotomized segments promotes osteogenic healing and contributes to postoperative stability. Since the masticatory muscles are repositioned close to their original anatomical position, muscle balance is preserved and relapse risk is reduced. Moreover, the low risk of complications has made this application clinically more reliable (Perciaccante & Bays, 2004).

2.9. Distraction Osteogenesis

This method, usually used alongside orthopaedic treatments, aims to reshape both bone structures and surrounding soft tissues by placing a distraction device between separated bone segments after an osteotomy in areas with deficient, short, or discontinuous bones (Dağ et al., 2011; Sailhan, 2011).

First developed by Wassmund and Rosenthal in 1926, this technique has become a routine treatment in cases where new bone formation is needed, and its use in the maxillofacial region has also increased in recent years (Sencimen et al., 2007; Yen et al., 2001).

The basic logic of distraction techniques is based on applying a stretching force to the callus of the bone. However, considering the force applied to the bone growth plates, it is possible to classify them as callotosis and physical distraction (Annino et al., 1994; Dağ et al., 2011). While physical distraction is performed with the forces applied to the bone growth plates (Dağ et al., 2011), callotosis distraction is performed by separating the fractured bone fragments from each other (Imola et al., 2002).

2.9.1. Distraction osteogenesis treatment consists of six main phases (Dağ et al., 2011):

2.9.1.1. Preoperative Phase: General clinical examination of the patient is conducted, and radiodiagnostic evaluations are performed for treatment planning.

2.9.1.2. Operative Phase: The bone segment to be distracted is separated through osteotomy, and the distraction device is fixed to the bone surface.

2.9.1.3. Latency Phase: After osteotomy, a 5–7 day period is given for soft tissue healing and initial callus formation, during which no force is applied.

2.9.1.4. Distraction Phase: The distraction device is gradually activated to pull the bone segments apart. This phase varies depending on the distraction rate, total distraction duration, and distraction rhythm.

2.9.1.4. Consolidation Phase: After distraction is completed, time is allowed for bone mineralization. It usually lasts 4–8 weeks, ideally twice the duration of the distraction phase (Ilizarov, 1988).

2.9.1.5. Retention Phase: The distraction device is removed, and if needed, orthodontic treatment is applied in this phase.

2.9.2. Indications for distraction osteogenesis in the maxillofacial region (Cohen Jr, 2002; Hunt & Flood, 2002):

2.9.2.1. Craniosynostoses (syndromic and non-syndromic)

2.9.2.2. Cleft lip and palate

2.9.2.3. Pierre Robin syndrome

2.9.2.4. Hemifacial microsomia

2.9.2.5. Bilateral pharyngeal arch defects (primary and secondary)

2.9.2.6. Deformities caused by trauma in the maxillofacial region (e.g., accidents, gunshot wounds, physical trauma, etc.)

2.9.2.7. Bone loss due to various causes, such as aging, malignant tumour resections, periodontal diseases, etc.

3. Distraction Osteogenesis Procedures in the Maxillofacial Region

3.1. Distraction Osteogenesis of the Maxilla and Midface

In patients with hypo-plastic maxilla, one of the treatment options is distraction applied to the midface and maxilla. This procedure can be performed independently of the mandible, and the applied force can be controlled in three dimensions (Samchukov & Cope, 2001).

In these cases, Rigid External Distraction (RED) is used. To perform this, the maxilla is first mobilized using a Le Fort I osteotomy (or its modifications). Following the osteotomy, the RED technique is applied to carry out the treatment (Samchukov & Cope, 2001).

Another method of distraction in the maxilla is called transpalatal distraction. This technique is used to correct transverse maxillary deficiencies of various causes via distraction osteogenesis (Mommaerts, 1999).

3.2. Mandibular Distraction Osteogenesis

Mandibular distraction is a technique often preferred in patients with mild asymmetries, severe mandibular deficiency, and/or mandibular hypoplasia (Kolstad et al., 2011). It's especially recommended in individuals whose hypo-plastic mandible is too underdeveloped to be corrected through orthognathic treatment alone.

The distractors used in this procedure are multifunctional, meaning they allow movement in all three planes. Mandibular distractors can be used not only for advancing a retrognathic/hypoplastic mandible, but also in cases involving anterior open bite (Dağ et al., 2011).

3.3. Alveolar Distraction Osteogenesis

Alveolar distraction osteogenesis is an effective surgical approach for the rehabilitation of various alveolar bone deficiencies. It is particularly preferred in cases where crest atrophy exceeds 4 mm, resulting in functional and aesthetic limitations for implant placement. In cases where the segmental alveolar ridge is insufficient and a proper crown–implant relationship cannot be achieved; in narrow alveolar bone structures that allow horizontal distraction; and in situations where tooth movement via orthodontic methods is either impossible or has failed—especially in the treatment of ankylosed teeth requiring gradual vertical mobilization—this method offers significant advantages. Furthermore, alveolar distraction osteogenesis is beneficial in cases requiring the vertical repositioning of osseointegrated implants together with the surrounding alveolar bone, in the rehabilitation of limited edentulous spaces (between two to four teeth), in tissue loss caused by traumatic events, in tooth loss due to periodontal disease, and in the reconstruction of congenital malformations. In all these scenarios, alveolar distraction osteogenesis has been clinically proven to be an effective treatment alternative (Annino et al., 1994; Hönig et al., 2002; Sailhan, 2011; Tavakoli et al., 1998).

3.4. Cleft Lip and Palate

The maxillofacial system develops between the 4th and 12th weeks of intrauterine life. During this period, various environmental, genetic, and/or etiological factors can disrupt embryonic development, resulting in the formation of cleft lip and/or palate (Nagase et al., 2010). In Türkiye, cleft lip and palate occur in 1 out of every 1,000 births, while globally, the incidence is around 1 in every 800–1,000 births (Tanaka et al., 2012; Yılmaz et al., 2019). Clefts are three times more common in males than in females (Shapira et al., 1999), and unilateral clefts occur three times more frequently than bilateral clefts (Shapira et al., 1999; Yağcı & Uysal, 2007).

Clefts may affect only the lip, only the palate, or occur as unilateral or bilateral combinations of both. Various classification systems exist for clefts. The first was developed in 1922 by Davies and Ritchie, categorizing clefts as prealveolar, postalveolar, and alveolar (Davis & Ritchie, 1922). In 1931, Veau based his classification on anatomical structures: soft palate and uvula; soft palate–hard palate and uvula; unilateral complete cleft of lip–alveolus–hard palate–soft palate and uvula; and bilateral clefts involving the same structures (Veau, 1931).

By 1958, cleft classification shifted to an embryological development model. Kernahan and Stark introduced a model based on primary and secondary palates, with distinctions for unilateral/bilateral and complete/incomplete clefts (Kernahan & Stark, 1958). In 1971, Kernahan added the famous striped "-Y-" diagram to improve data transfer and visualization (Kernahan, 1971).

This model was later modified by Elsahy in 1973, who added components such as the posterior pharyngeal wall, nasal floor, and premaxilla (Elsahy, 1973). In 1977, Millard contributed by adding inverted triangles to the striped "-Y-" to represent nasal alar deformities (Millard Jr, 1977).

By 1991, Friedman and colleagues, inspired by Elsahy and Millard's systems, added velopharyngeal closure and prolabium (Friedman et al., 1991). Around the same time, Otto Kriens developed a more user-friendly classification system based on "LAHSHAL" (Kriens, 1989). Later in 2009, Percy Rossell-Perry introduced the "Clock Diagram" classification system (Rossell-Perry, 2009).

3.4.1. Treatment Methods for Cleft Lip and Palate:

Treatment for individuals with cleft lip and palate begins from birth. To ensure that babies can feed properly, feeding plates are initially fabricated by orthodontists, allowing the infant to receive adequate nutrition. The goal here is to help the baby reach ideal weight and blood values for surgery (Erverdi, 2017). These plates are adjusted monthly to accommodate the child's growth.

After the initial feeding plate, appliances are used for nasoalveolar moulding, which help shape the nose and soft tissues. Additional attachments are placed on these plates to mould the nasal structures and bring the tissues closer together, thereby improving surgical outcomes and stability (Bennun et al., 2016).

Once babies reach a suitable weight and blood profile, surgeries begin, starting with soft tissues. Typically, the first lip surgery is performed between 2–5 months of age. The current approach is to perform a single surgery to close the palate defect during the 6–9 month range, which aligns with the phonation period (Bennun et al., 2016).

However, surgery timelines can vary depending on the complexity of the case, the baby's development, and tissue response.

Due to the surgeries performed during infancy, scar tissue inevitably forms, which can result in abnormal tooth eruption and/or maxillary growth anomalies. Therefore, these individuals must be followed from infancy to adulthood for ongoing evaluation and correction.

Initially, the eruption of teeth and presence of missing teeth should be monitored. During this stage, the potential for maxillary deficiency should be assessed, and if necessary, functional appliances such as face masks or Frankel III devices should be used (Dogan, 2012; Sahoo et al., 2023). If the growth phase has ended and the anomalies couldn't be corrected with functional treatments, orthognathic surgery should be considered (Posnick & Tiwana, 2006; Zaroni et al., 2024).

In children who drop out of follow-up care or are not properly monitored, oroantral fistulas may remain in the cleft line (Arthur et al., 2005). Such conditions can still be treated with the collaboration of orthodontists and oral and maxillofacial surgeons.

References

Angell, E. (1860). Treatment of irregularity of the permanent or adult teeth. *Dental Cosmos*, *1*, 599-600.

Annino, D. J., Goguen, L. A., & Karmody, C. S. (1994). Distraction osteogenesis for reconstruction of mandibular symphyseal defects. *Archives of Otolaryngology–Head & Neck Surgery*, *120*(9), 911-916.

Arthur, Z. R., Frank-Stephan, F., Wilhelm, G. K., Grätz, K., & Zwahlen, R. A. (2005). SARPE in patients affected by bilateral cleft lip and palate deformities: A technical note. *SADJ*, *60*(2), 000-000.

Athanasiou, A. E. (1993). Morphologic and functional implications of the surgical-orthodontic management of mandibular prognathism: A comprehensive review. *American journal of orthodontics and dentofacial orthopedics*, *103*(5), 439-447.

Aydin, U., Yilmaz, H., & Yildirim, D. (2004). Incidence of canine impaction and transmigration in a patient population. *Dentomaxillofacial Radiology*, *33*(3), 164-169.

Bell, W. (1975). Le Forte I osteotomy for correction of maxillary deformities. *Journal of Oral Surgery (American Dental Association: 1965)*, *33*(6), 412-426.

Bennun, R. D., Harfin, J. F., Sándor, G. K., & Genecov, D. (2016). Cleft lip and palate management.

Betts, N. J. (2016). Surgically assisted maxillary expansion. *Atlas of the oral and maxillofacial surgery clinics of North America*, *24*(1), 67-77.

Biederman, W. (1973). Rapid correction of Class III malocclusion by midpalatal expansion. *American journal of orthodontics*, *63*(1), 47-55.

Böckmann, R., Meyns, J., Dik, E., & Kessler, P. (2014). The modifications of the sagittal ramus split osteotomy: a literature review. *Plastic and Reconstructive Surgery–Global Open*, *2*(12), e271.

Buchanan, E. P., & Hyman, C. H. (2013). LeFort I Osteotomy. *Semin Plast Surg*, *27*(3), 149-154. https://doi.org/10.1055/s-0033-1357112

Buhara, O. (2013). *Le Fort I Osteotomileri Sonrası Maksillanın Değişik Miktarlardaki Posterior Hareketlendirmelerinin Oluşturduğu Etkilerin Sonlu Elemanlar Analizi Metodu İle Değerlendirilmesi* Yakın Doğu Üniversitesi]. Lefkoşa.

Chaushu, S., Brin, I., Ben-Bassat, Y., Zilberman, Y., & Becker, A. (2003). Periodontal status following surgical–orthodontic alignment of impacted central incisors with an open-eruption technique. *The European Journal of Orthodontics*, *25*(6), 579-584.

Cheever, D. (1870). Displacement of the upper jaw: Medical and surgical reports of the Boston City Hospital.

Cohen Jr, M. M. (2002). Malformations of the craniofacial region: evolutionary, embryonic, genetic, and clinical perspectives. *American journal of medical genetics*, *115*(4), 245-268.

Crescini, A., Clauser, C., Giorgetti, R., Cortellini, P., & Prato, G. P. (1994). Tunnel traction of infraosseous impacted maxillary canines. A three-year periodontal follow-up. *American Journal of Orthodontics and Dentofacial Orthopedics*, *105*(1), 61-72.

Dachi, S. F., & Howell, F. V. (1961). A survey of 3,874 routine full-mouth radiographs: II. A study of impacted teeth. *Oral Surgery, Oral Medicine, Oral Pathology*, *14*(10), 1165-1169.

Dağ, M., Karaçayll, Ü., & Dağ, C. (2011). Diş Hekimliğinde Distraksiyon Osteogenezi. *ADO Klinik Bilimler Dergisi*, *5*(3), 979-986.

Davis, J. S., & Ritchie, H. P. (1922). Classification of congenital clefts of the lip and palate: with a suggestion for recording these cases. *Journal of the American Medical Association*, *79*(16), 1323-1327.

Demirel, A., Canpolat, M. K., Orhan, K., & Sari, Ş. (2019). Batık Süt Molar Dişlerde Multidisipliner Tanı ve Tedavi Yaklaşımları. *Turkiye Klinikleri Pediatric Dentistry-Special Topics*, *5*(1), 35-42.

Dogan, S. (2012). The effects of face mask therapy in cleft lip and palate patients. *Annals of Maxillofacial Surgery*, *2*(2), 116-120.

Elsahy, N. I. (1973). The modified striped Y-A systematic classification for cleft lip and palate. *The Cleft palate journal*, *10*(3), 247-250.

Elsalanty, M. E., Genecov, D. G., & Genecov, J. (2007). Functional and aesthetic endpoints in orthognathic surgery. *Journal of Craniofacial Surgery*, *18*(4), 725-733.

Erverdi, N. (2017). *Çağdaş Ortodonti* Quintessence Publishing.

Friedman, H. I., Sayetta, R. B., Coston, G. N., & Hussey, J. R. (1991). Symbolic representation of cleft lip and palate. *The Cleft Palate-Craniofacial Journal*, *28*(3), 252-260.

Grøn, A.-M. (1962). Prediction of tooth emergence. *Journal of dental research*, *41*(3), 573-585.

Haas, A. J. (1961). Rapid expansion of the maxillary dental arch and nasal cavity by opening the midpalatal suture. *The Angle Orthodontist*, *31*(2), 73-90.

Hankinson, P., Brierley, C., & Brierley, D. (2024). A review of oral pathology in orthodontics. Part 2: Pathology of the jaw bones. *American journal of orthodontics and dentofacial orthopedics*, *165*(2), 131-142.

Harris, M., & Hunt, N. (2008). *Fundamentals of orthognathic surgery*. Imperial College Press.

Hönig, J. F., Grohmann, U. A., & Merten, H. A. (2002). Facial bone distraction osteogenesis for correction of malocclusion: a more than 70-year-old concept in craniofacial surgery. *Plastic and reconstructive surgery*, *109*(1), 41-44.

Hunt, J., & Flood, J. (2002). Craniofacial anomalies II: syndromes and surgery. *Sel Read Plast Surg*, *3*(25).

Ilizarov, G. A. (1988). The principles of the Ilizarov method. *Bulletin of the Hospital for Joint Diseases Orthopaedic Institute*, *48*(1), 1-11.

Imola, M. J., Hamlar, D. D., Thatcher, G., & Chowdhury, K. (2002). The versatility of distraction osteogenesis in craniofacial surgery. *Archives of Facial Plastic Surgery*, *4*(1), 8-19.

Kernahan, D. A. (1971). The striped Y—a symbolic classification for cleft lip and palate. *Plastic and reconstructive surgery*, *47*(5), 469-470.

Kernahan, D. A., & Stark, R. B. (1958). A new classification for cleft lip and cleft palate. *Plastic and reconstructive surgery*, *22*(5), 435-441.

Kokich, V. G., & Mathews, D. P. (2014). *Orthodontic and Surgical Management of Impacted Teeth* (1st ed.). Quintessence Publishing Co, Inc.

Kolstad, C., Senders, C., Rubinstein, B., & Tollefson, T. (2011). Mandibular distraction osteogenesis: at what age to proceed. *International Journal of Pediatric Otorhinolaryngology*, *75*(11), 1380-1384.

Kriens, O. (1989). LAHSHAL: A Concise Documentation System for Cleft Lip, Alveolus and Palate Diagnoses. In O. Kriens (Ed.), What Is Cleft Lip and Palate? A Multidisciplinary Update Workshop, Bremen 1987.".

Kuroe, K., Tomonari, H., Soejima, K., & Maeda, A. (2006). Surgical repositioning of a developing maxillary permanent central incisor in a horizontal position: spontaneous eruption and root formation. *The European Journal of Orthodontics*, *28*(3), 206-209.

Langenbeck, B. (1859). Beitrange zur Osteoplastik–Die osteoplastiche resection der Oberkierers. Deutsche Klinik. *A,(Ed). Berlin: Reimer*.

Lindauer, S. J., Rubenstein, L. K., Hang, W. M., Andersen, W. C., & Isaacson, R. J. (1992). Canine impaction identified early with panoramic radiographs. *The Journal of the American Dental Association*, *123*(3), 91-97.

Malik, N. A. (2012). *Textbook of oral and maxillofacial surgery*. JP Medical Ltd.

Millard Jr, D. R. (1977). *Cleft craft: the evolution of its surgery—volume II: bilateral and rare deformities*. Little Brown and Company.

Miloro, M., Ghali, G., Larsen, P., & Waite, P. (2004). Peterson's principles of oral and maxillofacial surgery. *Hamilton, Ont*.

Mitchell, L., & and Bennett, T. G. (1992). Supernumerary Teeth Causing Delayed Eruption—A Retrospective Study. *British Journal of Orthodontics*, *19*(1), 41-46. https://doi.org/10.1179/bjo.19.1.41

Mommaerts, M. (1999). Transpalatal distraction as a method of maxillary expansion. *British Journal of Oral and Maxillofacial Surgery*, *37*(4), 268-272.

Nagase, Y., Natsume, N., Kato, T., & Hayakawa, T. (2010). Epidemiological analysis of cleft lip and/or palate by cleft pattern. *Journal of maxillofacial and oral surgery*, *9*, 389-395.

Obwegeser, H. L. (2007). Orthognathic surgery and a tale of how three procedures came to be: a letter to the next generations of surgeons. *Clinics in plastic surgery*, *34*(3), 331-355.

Pahkala, R. H., & Kellokoski, J. K. (2007). Surgical-orthodontic treatment and patients' functional and psychosocial well-being. *American journal of orthodontics and dentofacial orthopedics*, *132*(2), 158-164.

Perciaccante, V. J., & Bays, R. A. (2004). Maxillary orthognathic surgery. *Principles of oral and maxillofacial surgery. Hamilton-London: BC Decker*, 1179-1204.

Pont, D. (1961). Retromolar osteotomy for the correction of prognathism. *J Oral Surg Anesth Hosp Dent Serv*, *19*, 42.

Posnick, J. C., & Tiwana, P. S. (2006). Cleft-orthognathic surgery. *Cleft lip and palate*, 573-585.

Proffit, W. R., Fields Jr, H. W., & Sarver, D. M. (2006). *Contemporary orthodontics*. Elsevier Health Sciences.

Rossell-Perry, P. (2009). New diagram for cleft lip and palate description: the clock diagram. *The Cleft Palate-Craniofacial Journal*, *46*(3), 305-313.

Sahoo, S. S., Dash, J. K., Sahoo, P. K., Das, S. K., Baliarsingh, R. R., & Ray, P. (2023). Early Orthodontic Intervention in Cleft Lip–Palate and Noncleft Children with Developing Class III Malocclusion: A Clinical Study. *International journal of clinical pediatric dentistry*, *16*(5), 716.

Sailhan, F. (2011). Bone lengthening (distraction osteogenesis): a literature review. *Osteoporosis international*, *22*, 2011-2015.

Samchukov, M. L., & Cope, J. B. C., Alexander M. . (2001). *Craniofacial Distraction Osteogenesis*. Mosby.

Sencimen, M., Aydintug, Y., Ortakoglu, K., Karslioglu, Y., Gunhan, O., & Gunaydin, Y. (2007). Histomorphometrical analysis of new bone obtained by distraction osteogenesis and osteogenesis by periosteal distraction in rabbits. *International journal of oral and maxillofacial surgery*, *36*(3), 235-242.

Sfeir, E., Gholmieh, M., Skaf, Z., & Mourad, A. (2018). Alveolar bone and epithelial attachment status following two different closed-eruption surgical techniques for impacted maxillary central incisors. *International Journal of Clinical Pediatric Dentistry*, *11*(4), 317.

Shapira, Y., Lubit, E., Kuftinec, M. M., & Borell, G. (1999). The distribution of clefts of the primary and secondary palates by sex, type, and location. *The Angle Orthodontist*, *69*(6), 523-528.

Sherwood, K. (2013). Evidence-based surgical-orthodontic management of impacted teeth. *Atlas of the Oral and Maxillofacial Surgery Clinics of North America*, *21*(2), 199-210.

Sugawara, T. (1990). A cooperative LAN diagnostic and observation expert system. 1990 Ninth Annual International Phoenix Conference on Computers and Communications,

Tanaka, S. A., Mahabir, R. C., Jupiter, D. C., & Menezes, J. M. (2012). Updating the epidemiology of cleft lip with or without cleft palate. *Plastic and reconstructive surgery*, *129*(3), 511e-518e.

Tavakoli, K., Stewart, K. J., & Poole, M. D. (1998). Distraction osteogenesis in craniofacial surgery: a review. *Annals of plastic surgery*, *40*(1), 88-99.

Thilander, B. (1979). Indications for orthodontic treatment in adults. *The European Journal of Orthodontics*, *1*(4), 227-241.

Thilander, B., & Myrberg, N. (1973). The prevalence of malocclusion in Swedish schoolchildren. *European Journal of Oral Sciences*, *81*(1), 12-20.

Tsai, T.-P. (2002). Surgical repositioning of an impacted dilacerated incisor in mixed dentition. *The Journal of the American Dental Association*, *133*(1), 61-66.

Vanarsdall, R. L., & Corn, H. (1977). Soft-tissue management of labially positioned unerupted teeth. *American journal of orthodontics*, *72*(1), 53-64.

Veau, V. (1931). Paris: Division Palatine Paris. In: Masson et Cie.

Vermette, M. E., Kokich, V. G., & Kennedy, D. B. (1995). Uncovering labially impacted teeth: apically positioned flap and closed-eruption techniques. *The Angle Orthodontist*, *65*(1), 23-32. https://doi.org/10.1043/0003-3219(1995)065<0023:Ulitap>2.0.Co;2

Woods, M., Wiesenfeld, D., & Probert, T. (1997). Surgically-assisted maxillary expansion. *Australian dental journal*, *42*(1), 38-42.

Yağcı, A., & Uysal, T. (2007). Tek Tarafli Dudak-Damak Yariğina Sahip Bebeklerde Nazoalveoler Şekillendirme Yönteminin Yarik Segmentler Ve Alveol Genişlikleri Üzerine Etkilerinin Değerlendirilmesi. *Sağlık Bilimleri Dergisi*, *16*(1), 1-11.

Yen, S. L., Shang, W., Shuler, C., & Yamashita, D.-D. (2001). Orthodontic spring guidance of bilateral mandibular distraction in rabbits. *American journal of orthodontics and dentofacial orthopedics*, *120*(4), 435-442.

Yılmaz, H. N., Özbilen, E. Ö., & Üstün, T. (2019). The prevalence of cleft lip and palate patients: a single-center experience for 17 years. *Turkish Journal of Orthodontics*, *32*(3), 139.

Zaroni, F. M., da Hora Sales, P. H., Maffia, F., & Scariot, R. (2024). Complications of orthognathic surgery in patients with cleft lip and palate: A systematic review. *Journal of Stomatology, Oral and Maxillofacial Surgery*, *125*(6), 101795.