CHAPTER 1

# Introduction to Orthodontics

## INTRODUCTION

The word "orthodontics" is derived from Greek words "orthos" meaning normal, correct, or straight and 'odontos' meaning teeth. Orthodontics deals with correction or improving the position of teeth and correcting any malocclusion. It should be remembered that malocclusion is not a pathology/disease but is simply a variation in the normal position of teeth. The term orthodontics was first coined by LeFoulon. In the past, the orthodontics was perceived to be related to the correction of irregular teeth only. But the recent era has witnessed comprehensive expansion of the scope of orthodontics and thereby elaborate understanding of the term. With the advent of knowledge, it has been proved that it is limited not only to the teeth, but also to the bones of face and surrounding craniofacial tissues. So, the concept of dentofacial orthopedics has born. The continuous research has helped to refine the clinical skills and knowledge, and consideration of soft tissues and smile of the patient in diagnosis and treatment planning.

## DEFINITION OF ORTHODONTICS

It is the branch of dentistry which deals with the study of growth and development of craniofacial complex, the occlusion and dentition, facial harmony and balance, prevention, interception and correction of malrelationship of jaws and teeth and achievement of harmonious relationship and balance. It includes all preventive, interceptive and corrective procedures to bring teeth and jaws in harmonious relation with each other and with the face of the individual, to establish normal occlusion and pleasing facial esthetics. Various definitions have been put forward in an attempt to define orthodontics.

**British Society of Orthodontics in 1922 defined it as** "Orthodontics includes the study of growth and development of the jaws and face particularly, and the body generally, as influencing the position of the teeth, the study of the action and the reaction of internal and external influences on the development, and the prevention and correction of arrested and perverted development".

**American Association of Orthodontists (1996)** adopted a more comprehensive definition in 1996. It defined orthodontics as "the area of dentistry concerned with the supervision, guidance and correction of the growing and mature dentofacial structures, including those conditions that require movement of teeth or correction of malrelationship and malformations of related structures by the application of forces and/or the stimulation and redirection of the functional forces within the craniofacial complex".

## HISTORY OF ORTHODONTICS

Crowded and irregular teeth have been a problem for many individuals since antiquity. Dental anomalies and malocclusion have been found in human skulls from Neanderthal era of around 50,000–60,000 years ago.

**Hippocrates** discussed dental irregularities in his books as early as 460–377 BC. Celsus (25 BC–50 AD) was the first person to suggest treatment of irregular tooth with the help of finger pressure. Pliny (23–79 AD) suggested

first mechanical method for treatment of irregular teeth.

Kniesel (1836) advocated the use of removable appliance, and also introduced impression trays. Pierre Fauchard (1928) gave Bandelette expansion arch to orthodontics. Norman Kingsley (1879) introduced bite plane and occipital anchorage. John Nutting Farrar (1839–1913) was the first person to write exclusively for orthodontics. In 1888, he wrote "treatise on irregularities of teeth and their correction".

The term "orthodontia" was given by LeFoulon (1839), while the term "orthodontics" was given by Murray. Orthodontics as a specialty emerged at the turn of 20th century with the efforts of Angle, who has been rightly called as **"Father of Modern Orthodontics"**. Angle (1899) described **classification** of malocclusion based on relation of permanent first molars, which is still relevant and widely used today. He described his concept of occlusion based on the **line of occlusion**. With continued research, he refined his work and contributed to the profession various fixed appliances to treat the malocclusions. He gave pin and tube appliance, ribbon arch appliance and then **the edgewise appliance** to the profession.

Angle (1921–27) introduced various modification of fixed appliances for treatment of malocclusion ultimately designing "edgewise appliance" for 3D control of teeth. All the systems present today are the modification of his original design, e.g. Andrew's SWA, Roth's PEA and MBT. Even Begg's appliance is a modified ribbon arch appliance designed by Angle. Edward H Angle, the father of modern orthodontics, gave the concept of line of occlusion.

Broadbent and Hoffrath's introduction of **cephalometry** (1941) started a new era in the practice and study of orthodontics, which helped us to quantify the growth and treatment changes. It proved to be a powerful tool for various researches to unfold the mystery of growth and development of craniofacial complex. Initially it was an art only, the dentist used to evaluate the face and teeth from an artist's eyes only, but with the subsequent researches, it was proved to be a science also, as it included biological tissues of bones, teeth and their supporting structures.

The main practice of US based orthodontists was mainly concerned with teeth and their correction, while in the parallel era, European orthodontists were using removable appliances and myofunctional appliances, mainly directed to correct the skeletal malrelationship of the jaws. So, the concept of dentofacial orthopedics has its roots in Europe. Field of molecular biology and genetics gives us increased understanding and appreciation of the complexity of orthodontics tooth movement.

Various modifications and development of materials have influenced the way nowadays the orthodontic treatment is done. Due to availability of tooth colored braces and wires; invisible/lingual braces; invisalign; shape memory wires, etc. more patients including adults have started opting for orthodontic treatment now due to inherent comfort and esthetics. It has involved 3D imaging, CBCT, etc. for research studies, diagnosis and treatment planning. Computers have got the roots in every walk of orthodontics now ranging from data storage, diagnosis, treatment planning, surgical planning, and fabrication of the appliances for treatment, e.g. invisalign. History of orthodontics is very vast, as the modern orthodontics can be traced to at least 125 years back, but the details are beyond the scope of this book.

## GOALS OF ORTHODONTICS

Goals of orthodontics include improvement of function, esthetics, stability and health of dentofacial tissues. It can be best described as **Jackson's triad**, i.e. functional efficiency, esthetic harmony, and structural balance.

### Functional Efficiency

Dentocraniofacial structures are involved in a number of functions, e.g. mastication, swallowing, respiration and speech. The normal interrelationship of various structures is

important for smooth functioning. Any disturbance in the relationship, e.g. disturbed muscular equilibrium, disturbed occlusion, etc. leads to various habits/abnormal forces on the dentofacial and other related structures.

### Esthetic Harmony

Esthetic/facial beauty is one of the foremost desires of any individual. Orthodontics helps to achieve the balanced, pleasing soft tissue structure in relation to underlying skeletal structures. Many malocclusions lead to poor esthetics and thus affect the person's psychological status. Orthodontics helps to improve the esthetics and thus the self-confidence of the person.

### Structural Balance

Factors causing disturbances of equilibrium of various forces lead to changes in adjacent structures. Thus by removing such causes, a structural balance can be achieved. All the structures, e.g. teeth, bone, soft tissues, etc. should be in prefect harmony and balance to achieve the optimal function and esthetics. It also helps in achieving stable orthodontic results.

### Sequelae of Malocclusion

Irregular teeth and disturbed functions may lead to pathological changes in the supporting tissues, further aggravating the health of dentofacial tissues. Some of the problems can be as follows:

- Poor facial appearance and negative psychosocial impact
- Abnormal functioning of the tissues
- Loss of soft tissues, gingival recession, etc.
- Risk of caries development
- Risk of development of periodontal diseases
- Abnormal growth and musculoskeletal patterns
- Risk of trauma to the teeth, TMJ, etc.
- Impaired speech.

### Needs for Orthodontic Treatment

Generally, there are three main reasons for doing orthodontic treatment:

1. To improve esthetics/dentofacial appearance
2. To correct the occlusal function of the teeth
3. To improve the health of the teeth and periodontium by eliminating faulty occlusion.

#### *Dentofacial Appearance*

Psychosocial and esthetic needs are one of the most important causes leading to orthodontic treatment. Well-aligned teeth and a pleasing smile carry a positive status, and help to boost confidence. People with irregular teeth refrain from laughing in public. A poor dental appearance may have broad psychosocial effects. So, the orthodontic treatment improves the psychosocial condition of the patients.

#### *Occlusal Function*

Harmonious function of orofacial tissues is very important for the overall health of associated tissues. Some of the abnormal functions associated with malocclusion can be as follows.

- Difficulty in mastication
- Severe malocclusion may make adaptive alterations in swallowing, thus disturbing neuromuscular equilibrium of the dental and facial structures.
- Difficulty in producing certain sounds, therefore speech therapy may be required, e.g. in cleft lip and palate patients.
- Greater incidence of temporomandibular disorders (TMDs). Improper occlusion of teeth leads to faulty mastication and may cause to temporomandibular joint (TMJ) dysfunction. However, the association with TMJ dysfunction and malocclusion has not been proved as yet.

### *Dental Health*

Overall dental health is of paramount importance for the longevity of the dental and supporting mechanism. There is a positive relationship of malocclusion to injury and dental disease.

- Due to crowding, teeth are difficult to clean, that leads to tooth decay and periodontal diseases. There is no strong connection between irregular teeth and dental caries or periodontal disease, if the person is able to maintain the oral hygiene. Although straight teeth may be easier to clean, a proper oral hygiene helps in preventing gingivitis and periodontitis.
- Other conditions which may cause long-term problems, e.g. anterior crossbite with an associated mandibular displacement leads to attrition of teeth, gingival recession, mobility of teeth, abnormal growth, etc.
- More prominent upper incisors are more prone to trauma. Reduction of large overjet minimises the risk of trauma to front teeth and improves esthetics and psychosocial benefits also, e.g. in Angle's class II division 1 cases.
- Deep overbite lead to gingival trauma and recession, e.g. on palatal side of upper incisors in class II division 1, and labial of lower incisors in class II division 2 cases. If it continues, there is a risk of early loss of the lower incisors.
- Trauma from occlusion: Abnormal stresses are transferred to supporting structures and TMJ, leading to chronic problems.

In order to assess the need for orthodontic treatment, various indices have been developed. **Index of orthodontic treatment need (IOTN)** ranks the malocclusion, in order, from worst to best. It has two parts, an esthetic component and a dental health component. The esthetic component is evaluated by comparing the patient's condition with a series of 10 photographs ranging from most to least attractive. The dental health component has a series of occlusal traits that could affect the long-term dental health. Various features are graded from 1–5 (least severe—worst). The worst feature of patient's malocclusion is matched to the list and an appropriate score is allotted. IOTN is a useful guide in prioritising treatment and determining treatment needs, but it does not consider the degree of treatment difficulty.

## Branches of Orthodontics

Orthodontics is a very vast field, since it has a long history of more than 125 years. It has evolved various treatment procedures to correct myriad of malocclusion conditions over the years. For simplification, these procedures can be divided into following mentioned branches. However, it should be understood that these treatment options are not limited to that branch and the age of the patients, but are generally overlapping and thus can be used at any stage of treatment as deemed necessary by the clinicians.

Orthodontics can be divided into following branches:

Few years back, the orthodontics used to have four branches, but clinical needs and demands led to evolution of 5th branch also.

1. Preventive orthodontics
2. Interceptive orthodontics
3. Corrective orthodontics
4. Surgical orthodontics
5. Adjunctive orthodontics/adult orthodontics.

They can be defined as follows for a proper understanding of the terms, as defined by Graber.

### *Preventive Orthodontics*

It may be defined as "the actions taken to preserve the integrity of what appears to be normal occlusion at a specific time". These actions are generally undertaken during primary dentition period.

### *Interceptive Orthodontics*

"It involves the procedures used to recognize and eliminate or reduce their severity the potential developing irregularities and malpositions in the developing dentofacial complex". These actions are undertaken during mixed dentition period especially growth phase.

### *Corrective Orthodontics*

It recognizes the existence of malocclusion and thus certain procedures are used to reduce or eliminate the problem and associated sequelae.

### *Surgical Orthodontics*

It involves the surgical procedures used for assisting the clinicians during orthodontic treatment. It can be divided into:

**Major surgical procedures:** These are the procedures which are used to treat major skeletal discrepancies, e.g. correction of cleft lip and palate, cosmetic surgeries, surgical assisted RME, and orthognathic surgeries, etc.

**Minor surgical procedures:** These procedures are used to assist the clinician during the fixed orthodontic treatment, e.g. it includes extractions for making spaces, exposure of impacted teeth for bonding and alignment in the arches, frenectomy, gingival contouring, laser surgeries, fixing of microimplants for anchorage, periodontal surgeries and grafting, transplantation of teeth, etc.

### *Adjunctive Orthodontics*

These are the procedures carried out to facilitate other dental procedures necessary to control other dental diseases and restore function and facilitate maintenance of oral hygiene. Thus in adult/older age groups, who have oral health problems and hence need orthodontic treatment as a part of an extensive/elaborate dental treatment plan, the adjunctive orthodontic procedures are used, e.g. uprighting of migrated/tilted teeth in extraction spaces of long standing duration to facilitate proper FPD formation or implant placement, extrusion of fractured teeth for restoration with post and core, closure of spaces in migrated teeth, etc.

## Conclusion

Orthodontics being the first specialty of dentistry has blossomed in a vast field with continued research and work contributed by great clinicians. The face is now considered from a three-dimensional perspective, even adding the fourth dimension in the form of "time", to assess and treat the patients. Skeletal, dental and soft tissues are given their due consideration during diagnosis and treatment planning. Consideration of smile of patient and soft tissue relation has evolved with continued work and has influenced the orthodontic treatment. Correction of skeletal malrelationship during active period of growth can be accomplished by myofunctional appliances and dentofacial orthopedic appliances. With the advent of latest materials and invisible braces, the thinking of the patients towards orthodontics has greatly modified and many adult patients are now opting for the orthodontic treatment. The use of microimplants has redefined the concept of anchorage during orthodontic treatment. The adjunctive orthodontic procedures have helped to achieve a better occlusion for the restoration of the remaining dentition and increasing the life of the remaining dentition and associated structures.