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Basavaraj Subhashchandra Phulari

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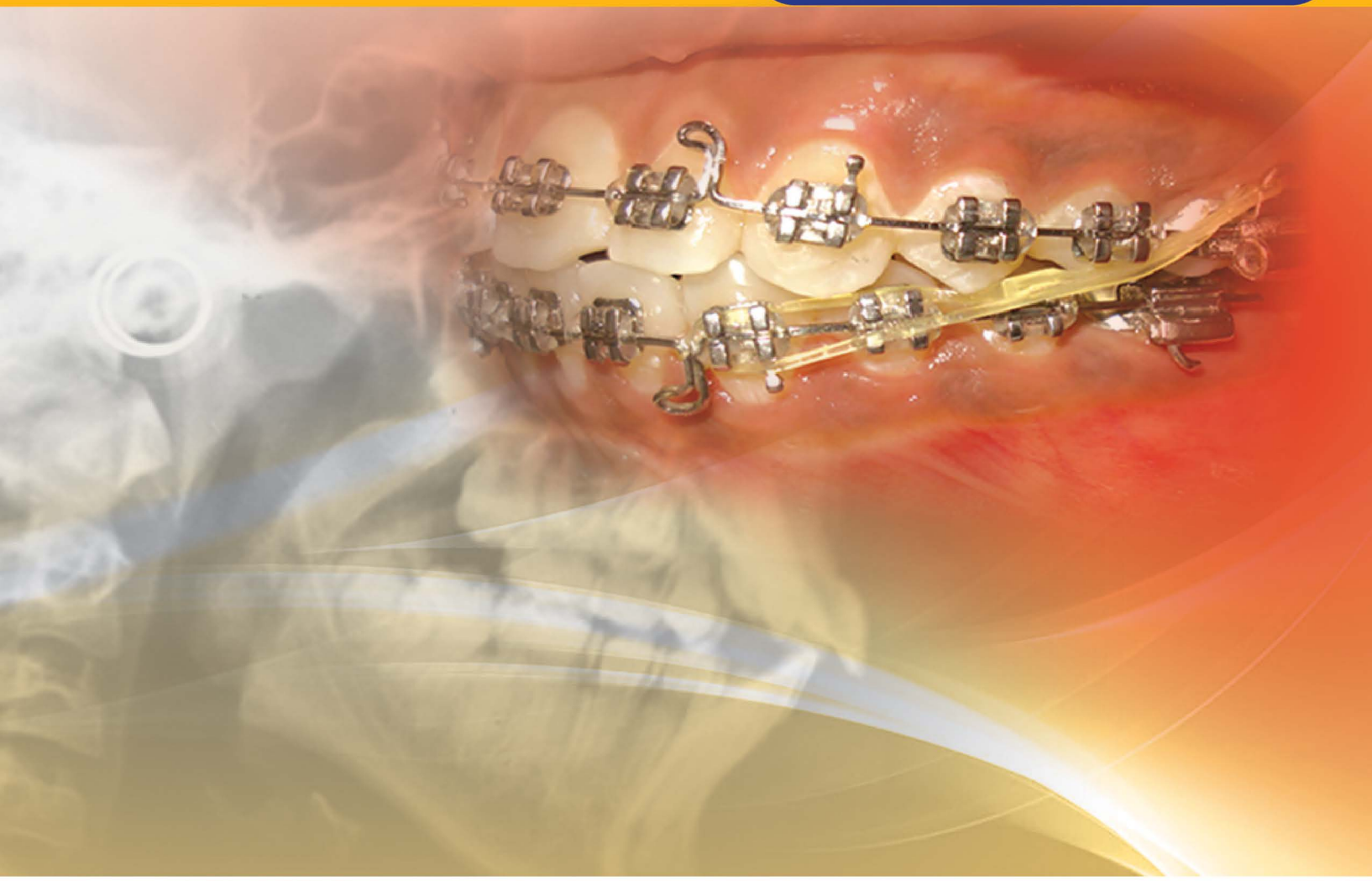

2nd Edition

JAYPEE

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CHAPTER

2

History

Phulari BS

Since the beginning of human history, human beings have understood at a very basic level that without a proper bite, survival is very difficult. If you cannot chew well, you cannot eat well. The remains of the ancient Egyptians, Romanians and the Etruscans show that these societies used various kinds of metal and wires to straighten or adjust the teeth.

Many advances in dentistry and some pioneering efforts in teeth straightening began in the eighteenth century, but it was really in the nineteenth century that orthodontics became a science of its own.

Many inventors have significantly contributed to the fascinating science of orthodontics. The person given the most credit for pioneering modern orthodontics is **Dr Edward H Angle,** who is rightly honored as the **"**Father of Modern Orthodontics.**"** Publication of Angle's classification system of malocclusion in 1899 marked a turning point in the history of orthodontics, paving way to establishment of the oldest specialty of dentistry.

The history of orthodontics is interesting and at the same time complex. It is the oldest specialty of dentistry. It would be wise to follow the development of this exciting field of science right from the era of ancient civilization to the current times. Prior to 1900s, the specialty of orthodontics was referred as "Regulation of Teeth" and as "Orthodontia" up to 1930s. The term "Orthodontics" has been used up to 1970s and currently the speciality is addressed as "Orthodontics and Dentofacial Orthopedics" **(Table 2.1)**.

ANCIENT CIVILIZATION

The history of orthodontics has been intimately interwoven with the history of dentistry for more than 2,000 years. Dentistry in turn, has its origins as a part of medicine **(Table 2.2)**.

The Greek physician, **Hippocrates (460–377 BC),** was the first to separate medicine from fancy or religion. He established a medical tradition based on facts and the collected information was gathered into a text known as the "Corpus Hippocraticum." This text of the pre-Christian era contains many references to the teeth and to the tissues of the jaws as part of the medical text, which includes descriptions of irregularity and crowding of teeth.

Aristotle (384–322 BC), the Greek philosopher, was the first writer who studied the teeth in a broad manner. In his work entitled, "De Partibus Animalium" (On the Parts of Animals), he compared various dentitions of the known species of animals of that time.

Aulus Cornelius Celsus (25 BC–50 AD), the prominent Roman author of the first century, described finger pressure to move teeth in his work "De Re Medicina" (On Medicine).

"When in a child a permanent tooth appears before the fall of the milk tooth, it is necessary to dissect the gum all around the latter and extract it. The other tooth must then be pushed with the finger, day by day, towards the place that was occupied by the one extracted and this is to be continued until it reaches its proper position."

Table 2.1: Evolution of term orthodontics

- Orthodontics
- Regulation prior to 1900s
- Orthodontia up to 1930s ("ia" referred to a medial condition)
- Orthodontics up to 1970s
- Currently orthodontics and dentofacial orthopedics

MIDDLE AGES THROUGH SEVENTEENTH CENTURY

There is little reference to dentition during this period. An Arabic physician, **Paul of Aegina (Paulus Aeginata, 625–690)** wrote about irregularities in the dental arches caused by supernumerary teeth. He advised extraction of such teeth.

Ambrose Paré (1517–1590), a French surgeon, paid specific attention to the cleft palate. He was the first surgeon to devise an obturator for the treatment of cleft palate.

EIGHTEENTH CENTURY

Eighteenth century witnessed major events in the development of **dental science dentistry**. France was the leader in dentistry throughout the world in this century. This was mainly due to one person named **Pierre Fauchard**. No one person exerted a stronger influence on the development of the profession than he did. In fact, he is referred to as the "Founder of Modern Dentistry." He created order out of chaos, developed a profession

Table 2.2: Ancient civilization

Years	*Authors*	*Contributions to orthodontics*
460–377 BC	Hippocrates	Description of irregularity of teeth in "Corpus Hippocraticum".
384–322 BC	Aristotle	Comparison of various Dentitions of different species of animals in his work "De Partibus Animalium".
25 BC–50 AD	Aulius Cornelius Celsus	Described finger pressure to move teeth in his work "De Re Medicina."

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out of a craft and gave to this new branch of medicine a scientific and sound basis for the future. He published his two-volume book entitled "The surgeon dentist, a treatize on the teeth", which had an entire chapter on ways to straighten teeth. With reference to orthodontics, as early as 1723, he developed what is probably the first orthodontic appliance. It was called **Bandelette (Fig. 2.1).** It was designed to expand the arch, particularly the anterior teeth and was the forerunner of the expansion arch of modern times **(Table 2.3)**.

John Hunter (1728–1793), an English surgeon and a great teacher of anatomy, published his book "The Natural History of the Human Teeth" in 1771. He demonstrated the growth, development and articulation of the maxilla and the mandible and outlined the internal structure of the teeth and bone and their separate functions. He gave the basic nomenclature of dentistry incisors, bicuspids and molars.

The art of modern dentistry based on scientific foundation was first developed in Europe. It then came to the United States through the European-trained "Operators for the teeth" who came to America seeking fresh opportunities. Many native practitioners of America then began to "regulate" teeth. Malocclusion was called "irregularities" and their correction "regulation" during this period.

NINETEENTH CENTURY

Foundations were laid in the nineteenth century to the oldest specialty of dentistry—Orthodontics. It was in the latter part of the nineteenth (1880s) century that the specialty began to emerge **(Table 2.4)**.

By the mid-nineteenth century, basic concepts of diagnosis and treatment had begun. It was a time when each practitioner attempted treatment by devising their own method based on purely mechanical principles. At that time, orthodontics was part of prosthetic dentistry and the literature on the subject described orthodontics in the area of partial or total replacement of missing teeth.

Table 2.3: Contribution to orthodontics in 18th century

Year	*Authors*	*Contributions to orthodontics*
1723	Pierre Fauchard	▪ Father of modern dentistry ▪ He published his two-volume book entitled "The Surgeon Dentist, A Treatise on the Teeth" ▪ Developed first expansion appliance called "Bandelette"
1728–1793	John Hunter	▪ Natural history of teeth ▪ Growth and development of jaws ▪ Internal structure of teeth ▪ Functions of teeth

Table 2.4: Contribution to orthodontics in 19th century

Year	*Authors*	*Contributions to orthodontics*
1841	William Lintott	Introduced the use of screws
1840	JS Gunnell	Introduced chin strap
1860	Emerson C Angel	▪ First to introduce Arch Expansion by opening midpalatal suture ▪ Father of expansion appliances
1871	William and Magill	Developed molar bands
1888 and 1889	John Nutting Farrar	▪ "Father of American orthodontics" ▪ Wrote "Irregularities of the Teeth and Their Correction" ▪ Textbook was the first great work devoted exclusively to orthodontics ▪ Laid the foundation for "Scientific orthodontics" (intermittent forces, limits to amount of tooth movements)
1829–1913	Norman N Kingsley	▪ Treatise on oral deformities "worked on correction of cleft palate" ▪ Extraoral traction.
1893	Henry A Baker	Baker's anchorage Intermaxillary elastics)

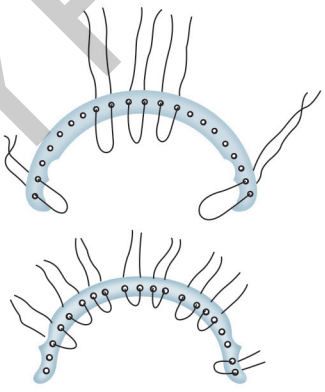

Fig. 2.1: Bandelette designed by Pierre Fauchard to expand dental arches

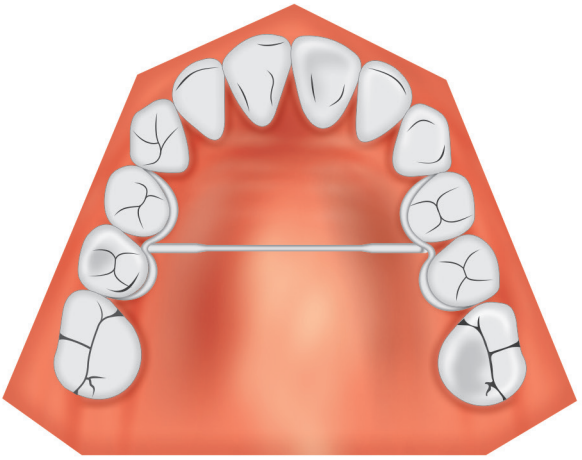

Fig. 2.2: Expansion appliance developed by Emerson C Angel

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As early as in 1841, **William Lintott** introduced the use of screws in his work "On the teeth." He described premature loss of deciduous teeth as a cause of malocclusion, recommended that treatment be begun between the age of 14 and 25 years and also described a bite opening appliance.

JS Gunnell, in 1840, introduced the chin strap as occipital anchorage for the treatment of mandibular protrusion, the principle of which is used even today.

Emerson C Angel (1823–1903), in 1860, was the first to advocate the opening of the median suture to provide space in the maxillary arch, since he strongly opposed extraction **(Fig. 2.2)**. This began the use of arch expansion in orthodontics.

William and Magill developed molar bands on the teeth as early as in 1871.

It was not until the latter part of the nineteenth century, when a few dedicated dentists gave special attention and importance to this phase of dentistry, that orthodontics began to emerge as a specialty science. It was known at that time as 'Orthodontia', the suffix 'ia' referred to a medical condition. In the last three decades of nineteenth century, some great contributors were made to the specialty by the following dentists.

John Nutting Farrar (1839–1913) is often referred as the "Father of American Orthodontics". It was he who gave impetus to the scientific investigations that permitted the understanding of the theory and practice of orthodontics. During his studies, he investigated the physiologic and pathologic changes occurring in animals as the result of orthodontically induced tooth movement.

He published two volumes entitled "Irregularities of the Teeth and Their Correction" in 1888 and 1889. The textbook was the first great work devoted exclusively to orthodontics. Farrar was good at designing brace appliances and was the first to suggest the use of mild force at timed intervals to move teeth "in regulating the teeth, the traction must be intermittent and must not exceed certain fixed limits." He was also the first to recommend root or bodily movement of the teeth.

Another man who also deserves much credit during this period of time is **Norman N Kingsley (1829–1913),** a prominent dentist, artist/sculptor and orthodontist **(Fig. 2.3)**. He is known for his works on "Correction of cleft palate". As early as in 1866, he devised a technique called "Jumping the bite" with the use of a bite plane. He used vulcanite on conjunction with ligatures, elastic bands made of rubber, jackscrews and the chin cap.

Henry A Baker is remembered for the introduction of the so called Baker's anchorage or the use of the intermaxillary elastics with rubber bands in 1893 **(Fig. 2.4).**

TWENTIETH CENTURY

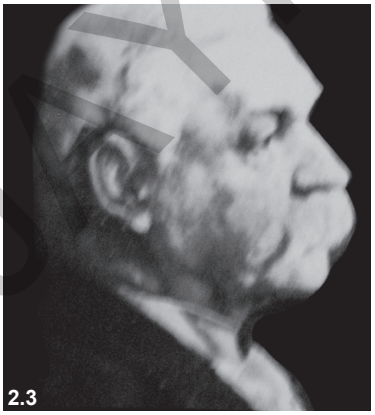
Angle's Contribution to Orthodontics

One of the most dominant, dynamic and influential figures in the specialty of Orthodontics was **Edward Hartley Angle (1855–1930) (Fig. 2.5).** He is rightly regarded as the "Father of Modern Orthodontics." **(Table 2.5)**

Edward H Angle was born on June 1, 1855, in Herrick, Pennsylvania. He completed DDS degree from Pennsylvania College of Dental Surgery in 1878. He joined the faculty of the Dental Department of the University of Minnesota in 1886. In the year 1892, He resigned from the University of Minnesota and moved to Chicago and then he became the first professor of Orthodontics at Northwestern University School of Dentistry. In 1895, Angle completed his MD degree from Marion Sims College. He moved to St. Louis, assuming the professor post first at Marion Sims College of Medicine and shortly afterwards at Washington University Dental School. It was then that he started his first orthodontic case, on his preceptor's son. Experiences in various schools led him to the conviction that orthodontia could not be properly

Table 2.5: Angle's contribution to orthodontics

Text book "Irregularities of the Teeth"	1887 (1st edition)
Classification of malocclusion	1899
E-Arch appliance	1900
Pin and tube appliance	1901
Ribbon arch appliance	1910
Edgewise appliance	1925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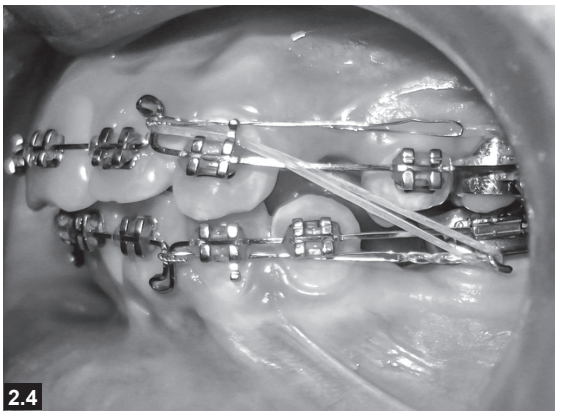
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Fig. 2.3: Norman N Kingsley (1829–1913); **Fig. 2.4:** Intermaxillary elastics: **Fig. 2.5:** Edward Hartley Angle (1855–1930)

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taught in a dental college. He started the first school of orthodontia in 1900, named as "**The Angle School of Orthodontia**" at St. Louis.

Edward H Angle organized the first orthodontic society and called it as "**The Society of Orthodontists."** In 1935, the Society adopted the name it bears today: **The American Association of Orthodontists (AAO).** They also established the magazine, a quarterly titled **The American Orthodontist,** which we read today as the **American Journal of Orthodontics.**

1903 — Dr. Anna Hopkins was elected the Society's first Secretary. She completed one of the early Angle courses, but was never to practice orthodontia. In 1906 she became Mrs Edward Hartley Angle.

Appliances Contributed by Angle

- In 1900, Edward H Angle developed his first orthodontic appliance, the "E" (expansion)-arch appliance. It is also referred to as Edward Angle's E-arch. E-arch appliance consists of bands which are placed on molar teeth on either side of the arch of a heavy labial arch wire extended around the arch. The ends of labial extended arch wire threaded to the buccal aspect of the molar bands allowed the arch wire to be advanced so that the arch perimeter is increased. Individual teeth were ligated with the heavy labial extended arch wire with ligature wire of 0.010".
- Pin and tube appliance was developed in 1901. In this pin and tube appliance, all teeth are banded. Vertical tubes were welded to the bands on the labial surface in the center of the crown for all teeth in the arch. Arch wires were secured with soldered pins that inserted into the vertical tubes. Tooth movement was achieved by altering the placement of these pins.
- Angle developed Ribbon arch appliance in 1910. It is a modification of pin and tube appliance. Ribbon arch was the first appliance to use a true bracket. The bracket has a vertical slot facing occlusally. The brackets were attached to the bands at the center of labial surface of teeth.

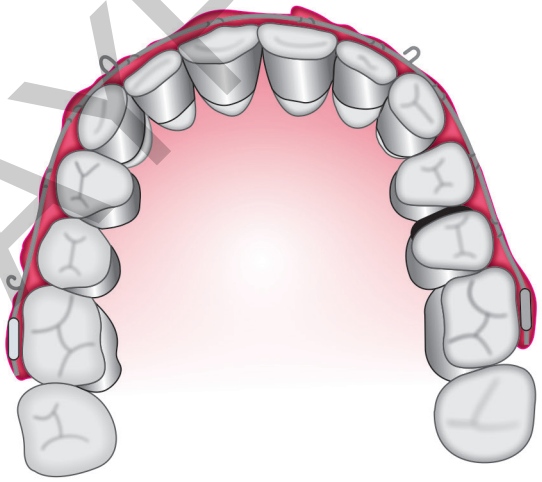

Fig. 2.6: Edgewise appliance

- Edgewise appliance was developed and introduced to orthodontics by Edward H Angle in the year 1925 which formed the basis of all fixed orthodontic techniques in use today. In order to overcome the deficiencies encountered with his previous techniques Angle developed the edgewise bracket that could give a better control over individual tooth movement **(Fig. 2.6)**.

The unique feature of rectangular arch wire in a rectangular slot of the edgewise bracket enabled control of tooth movement in all three planes of space. Subsequent development of various fixed orthodontic appliances such as Straight wire appliance, pre adjusted edgewise appliance are actually modifications of the standard edgewise appliance of Angle.

Edward H Angle's Publications and Presentations

- Angle presented his first scientific paper at the Ninth International Medical Congress in 1887.
- Published the first edition of his textbook 1887 which would go through seven editions under the following titles:

1. *Irregularities of the Teeth*, 1887.
2. *A System of Appliances for Correcting Irregularities of the Teeth*, 1890.
3. *The Angle System of Regulating and Retention of the Teeth*, 1892.
4. *The Angle System of Regulation and Retention of the Teeth—with an Addition of Treatment of Fractures of the Maxillae*, 1895.
5. *Angle System of Regulation and Retention of the Teeth and Treatment of Fractures of the Maxillae*, 1899.
6. *Malocclusion of the Teeth and Fractures of the Maxillae*, 1900.
7. *Treatment of Malocclusion of the Teeth*, 1907.

- Angle published his famous article "The Classification of Malocclusion" in the Dental Cosmos, 1899. His classification provided an intelligent and easily understood means of communication among members of the dental profession. Angle believed that the maxillary first molars were the key to occlusion and his system of classification divides malocclusions in anteroposterior/sagittal plane only. Despite this drawback, Angle's classification system has stood the test of time and is still the most commonly used method of classifying malocclusions, more than 100 years since he first proposed it.

Though Angle died in 1930 (August 11th), his influence is still felt strongly in orthodontics. His concept of normal occlusion and establishment orthodontia as a specialty science will remain Angle's greatest monument. Characteristic of the man was a remark made shortly before he died: "I have finished my work. It is as perfect as I can make it."

Another distinguished orthodontist was **Calvin S Case (1847–1923) (Fig. 2.7)**. He developed a classification of malocclusion that included 26 divisions. Case published his major work "A practical treatise on the techniques and

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principle of dental orthopedic and prosthetic correction of the cleft palate." Case was a strong advocate of the relationship of malocclusion to facial improvement. Facial improvement was a guide to treatment. He was also a strong proponent of extraction theory in orthodontics.

Charles A Hawley (1861–1929) used a celluloid sheet containing a geometric figure that when adapted to a model determined the extent of proposed tooth movement (1905) and introduced the retainer appliance that bears his name (1908) **(Fig. 2.8)**.

HD Kesling (1945) introduced his philosophy of tooth movement by using a rubber tooth positioning device in which the teeth were moved into a more ideal cuspal relationship after major correction has been accomplished.

History of Cephalometrics

Ever since God created man in His image, man has been trying to change man into his image. Attempts to change facial appearance are recounted throughout recorded history. The question of what is a normal face, as that of what constitutes beauty, will probably never be answered in a free society. **(Table 2.6)**

Orthodontists, in their attempts to change facio-oro-dental deviations from accepted norms, have adopted cephalometric measurement, a method long employed in physical anthropology. With the introduction of roentgenography, it was inevitable that this procedure should be employed as a medium for the purpose of roentgenographic cephalometrics.

Cephalometric radiography was introduced to orthodontics during the 1930s.

Cephalometry had its beginnings in craniometry. **Craniometry** is defined in the Edinburgh encyclopedia of 1813 as "the art of measuring skulls of animals so as to discover their specific differences". For many years anatomists and anthropologists were confined to measuring craniofacial dimensions using the skull of dead individuals. Although precise measurements were possible craniometry has the disadvantage for growth studies.

Cephalometry is concerned with measuring the head inclusive of soft tissues, be it living or dead. However, this procedure had its limitations owing to the inaccuracies that resulted from having to measure skulls through varying thickness of soft tissues.

With the discovery of X-rays by Roentgen in 1895, **radiographic cephalometry** came in to being. It was defined as the measurement of head from bony and soft tissue land marks on the radiographic image (Krogman and Sassouni 1957). This approach combines the advantages of craniometry and anthropometry. The disadvantage is that it produces two-dimensional image of a three-dimensional structure.

In **1895, Professor Wilhelm Conrad Roentgen** made a remarkable contribution to the field of science with the discovery of X-rays. On December 28, 1895, he submitted a paper **"On A New Kind of Rays, A Preliminary Communication"** to the Wurzburg Physical Medical Society for publication in its journal.

Professor Wilhem Koening and Dr Otto Walkhoff simultaneously made the first dental radiograph in **1896**. It was clear that the use of X-rays provided the means of obtaining a different perspective on the arrangement

Table 2.6: Cephalometry

Year	*Authors*	*Contributions to orthodontics*
1899–1996	William B Downs	▪ Cephalometric appraisal of orthodontic results ▪ Down's analysis
1900–1984	Herbert I Margolis	Tweeds triangle
1913–1966	Wendell L Wylie	Analysis based on dividing dimensions along the Frankfort plane into contributing linear components
1922–1994	Richard A Riedel	ANB angle
1967	Alexander Jacobson	The Wit's analysis



Fig. 2.7: Calvin S Case (1847–1923)

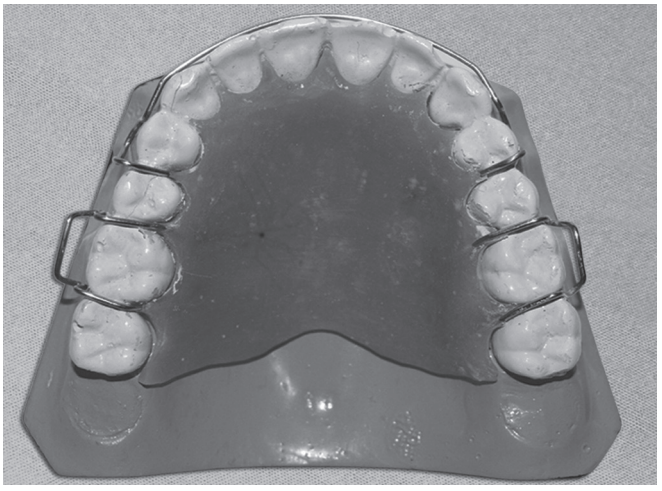

Fig. 2.8: Hawley's retainer introduced by Charles A Hawley

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and relation of bones thus expanding the horizons of craniometry and cephalometry.

The first X-ray pictures of skull in the standard lateral view were taken by **AJ Pacini** and **Carrera in 1922**. Pacini received a research award from the American Roentgen Ray Society for a thesis entitled **"Roentgen Ray Anthropometry of the Skull"**. Pacini introduced a teleroentgenographic technique for standardized lateral head radiography and thereby opened, what proved to become a tremendous advance in cephalometry, as well as in measuring the growth and development of face. His method, which was rather primitive, involved a large fixed distance from the X-ray source to the cassette. The head of the subject, placed adjacent to a standard holding the cassette, was immobilized with a gauze bandage wrapped around both the face and the cassette after the patient's midsagittal plane was carefully oriented parallel to the cassette.

He identified the following anthropometric landmarks on the roentgenogram: gonion, pogonion, nasion, and anterior nasal spine. He also located the center of the sella turcica and the external auditory meatus. He measured the gonion angle and the degree of maxillary protrusion.

In **1931** the methodology of cephalometric radiography came to full function when **B Holly Broadbent in USA and H Hofrath in Germany** simultaneously published methods to obtain standardized head radiographs in the Angle Orthodontist **(A new X-ray technique and its application to orthodontia)** and in Fortschritte der Orthodontie, respectively.

This development enabled orthodontists to capture the field of cephalometry from the anatomists and anthropologists who had monopolized craniometric studies, particularly in nineteenth century.

B Holly Broadbent's Contribution

B Holly Broadbent (1931) published an article in the first issue of the new Angle Orthodontist titled "A New X-ray technique and its application to orthodontia." It was the introduction to the specialty and to dentistry of cephalometric roentgenography **(Fig. 2.9)** and of course, cephalometric tracing and evaluation. Broadbent devised the roentgenographic cephalometer, which is the instrument that accurately positions the head relative to the film and the X-ray source. His study, supported by the Bolton family, consisted of a longitudinal study of 3,500 school children from birth to adulthood. In honor of his sponsor, Broadbent established a new point of reference on the skull, known as the Bolton point.

Broadbent's interest in craniofacial growth began with his orthodontic education under EH Angle in 1920. He continued to pursue that interest along with his orthodontic practice, working with a leading anatomist **J Wingate Todd.**

The uncertainty of locating land marks in the skull of the living child by approaching through skin and soft tissues led him to search for a means of recording craniometric landmarks on the living child as accurately as done with a craniostat in measuring the dead skull.

During 1920s, Broadbent refined the craniostat into craniometer by the addition of metric scales. That proved to be the first step in the evolution of craniostat into a radiographic cephalostat. It did not take him much longer to convert the direct measuring instrument into a radiographic craniometer.

Meanwhile the course of Broadbent's orthodontic practice he corrected the malocclusion of **Charles Bingham Bolton,** son of **Chester** and **Francis P Bolton.** His discussions of facial growth with Congress woman Bolton led to the addition of Bolton study of facial growth to the long list of Bolton philanthropies. As Charles grew to adulthood this study became a major personal as well as financial commitment.

Cephalometrics was neither developed as a technique looking for an application nor was it developed as a diagnostic tool. Broadbent's single goal was the study of craniofacial growth. The Broadbent technique for cephalometric radiography was one of the tools that he developed for the implementation of that study.

The technique and apparatus perfected for the **Bolton Fund study of the normal developmental growth of the face**, eliminated practically all of the technical difficulties encountered in previous methods of recording dento-facial changes, and proved to be a convenient as well as scientific method of measuring orthodontic procedures.

According to Broadbent the patient's head was centered in the cephalostat with the superior borders of the external auditory meatus resting on the upper parts the two ear rods. The lowest point on the inferior bony border of the left orbit, indicated by the orbital marker, was at the level of the upper parts of the ear rods. The nose clamp was fixed at the root of the nose to support the upper part of the face. The focus film distance was set at 5 feet (152.4 cm) and the subject film distance could be measured to calculate image magnification. With the two X-ray tubes at right angles to each other in the same horizontal

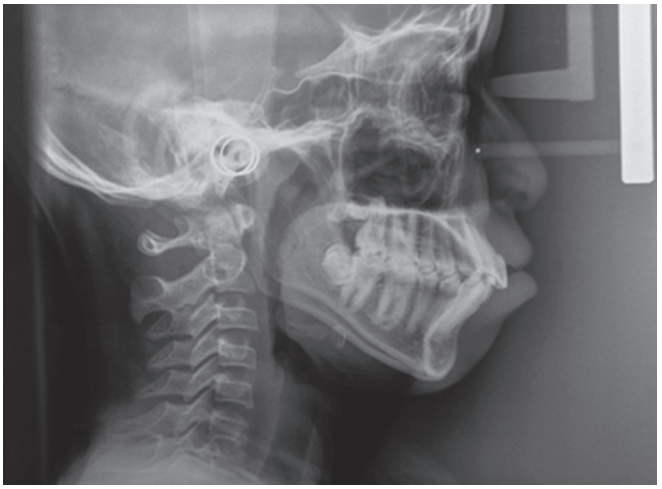

Fig. 2.9: Cephalometric roentgenography (Lateral cephalogram)

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Fig. 2.10: William B Downs (1899–1996); **Fig. 2.11:** Herbert I Margolis (1900–1984); **Fig. 2.12:** Richard A Riedel (1922–1994)

plane, two images (lateral and posteroanterior) could be simultaneously produced.

While Germany's Hofrath's technique differed from Broadbent's in that the path of the central ray was not fixed in relation to the head and no plan was suggested for superpositioning subsequent X-rays.

William B Downs (1899–1996) (Fig. 2.10) was a mainstay of the teaching staff at Illinois's. With Brodie, Goldstein, and Myer, he coauthored "Cephalometric appraisal of orthodontic results" (1938).

Margolis (1900–1984) (Fig 2.11) wrote on the relationship between the inclination of the lower incisor and the incisor-mandibular plane angle and was the first to corroborate Tweed's clinical observation that, in normal occlusions, the lower incisors are 90° to the mandibular basal bone.

In **1947, Wylie** produced a method of assessing anteroposterior dysplasias, and, that same year, Margolis contributed his maxillofacial triangle.

Cephalometric Analysis

The major use of radiographic cephalometry is in characterizing the patient's dental and skeletal relationships. This led to the development of a number of cephalometric analyses to compare a patient to his or her peers, using population standards. **William B Downs in 1948** developed the first cephalometric analysis. Its significance was that it presented an objective method of portraying many factors underlying malocclusion and there could be a variety of causes of malocclusion exclusive to teeth. This was followed by other analyses by Cecil C Steiner (1953), C H Tweed (1953), RM Ricketts (1958), V. Sassouni (1969), HD Enlow (1969), JR Jaraback (1970), and Alex Jacobson (1975), etc.

Richard A Riedel (1922–1994): Even before completing his master's requirements at Northwestern University, Richard A Riedel **(Fig. 2.12)**, introduced one of the most widely accepted diagnostic cephalometric measurement in use, that is, ANB angle.

REMOVABLE ORTHODONTIC APPLIANCE

Removable orthodontic appliances are so called because they are designed to be fitted and removed by the patient. Removable orthodontic appliances are limited to tipping and simple rotator movements of teeth, which are sufficient for many orthodontic treatments. They depend on co-operation and a certain degree of skill on the part of the patient. Removable orthodontic appliances may be active or passive.

The use of removable orthodontic appliances was always more popular in Europe than the United States, but even there the use of fixed appliances (using bands and brackets) has largely become the primary method of treatment. Nevertheless, removable appliances are often an effective means of addressing many patients' needs and in some cases have considerable advantages over fixed appliances.

Removable orthodontic appliance consists of following three components:

1. Retentive components
2. Active components
3. Base plate.

Retentive Components

The success of a removable orthodontic appliance mainly depends upon good retention of the appliance. Adequate retention of a removable orthodontic appliance is achieved by incorporating certain wire components, which get engaged into the undercuts on the teeth. These wires components that help in retention of a removable appliance are called clasps.

Clasps

Clasps are the retentive components of removable orthodontic appliances. Following are the researchers, involved in the design of various types of clasps **(Table 2.7).**

Bows

Bows are one of the active components of removable orthodontic appliance. They are usually used for overjet

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Table 2.7: Clasps

S. no	Types of clasp	Designed by
1.	Adam's clasp	CP Adams
2.	Schwartz clasp	Schwartz
3.	Crozat clasp	Crozat

Table 2.8: Expansion orthodontic appliances

S. no	Type of expansion appliance	Developed by
1.	Derichsweiler expansion appliance	Derichsweiler
2.	Issacson's expansion appliances	Issacson
3.	Hass expansion appliance	Hass
4.	Coffin spring	Walter Coffin
5.	Jack expansion screw	Jack

retraction of anteriors. They can also be used for space closure in the anterior segment as well as space distal to canines. The following are some of the routinely used design of labial bows:

1. Short labial bow
2. Long labial bow
3. Split labial bow
4. Modified split labial bow
5. Reverse labial bow
6. Robert's retractor
7. Mill's retractor
8. High labial bow
9. Filled labial bow

BASE PLATE

Base plate has a greater percentage of bulk in removable orthodontic appliance than other components. The design of base plate varies with the type of removable orthodontic appliance. Self cure or autopolymerizing acrylic resins are used for the fabrication of base plate. It joins all other (active and retentive) components of removable orthodontic appliance together into a single functional unit.

EXPANSION ORTHODONTIC APPLIANCES

Expansion orthodontic appliances are used to relieve crowding in cases of arch length–tooth material discrepancy. Following are the researchers involved in the development of various types of expansion appliances **(Table 2.8)**.

MYOFUNCTIONAL/FUNCTIONAL ORTHODONTIC APPLIANCES

The term functional appliance means that when the appliance is fully seated in the mouth, the mandible is forced into an eccentric/noneccentric relation position. Any such mandibular posture causes the musculature to try to move the mandible toward a centric position. This results in force systems being exerted whenever the appliance is mounted on the teeth or soft tissues of the mouth.

Although functional appliances have been used throughout the century in Europe and in the last 40 years in the United States, it was not until the late 1960s that scientific data were available to evaluate the empiric rationalization for their clinical effectiveness. This early data consisted of animal experiments demonstrating histologic and radiographic evidence of increased growth of the condylar cartilage when the mandible was held in a forward position. Petrovic suggested that the unique characteristics of the condylar cartilage, including cell division of the prechondroblast (as opposed to the chondroblast in epiphyseal cartilage of the long bones or cartilage in the synchondroses of the cranial base) make this cartilage more responsive to orthopedic devices. The animal studies of the 1960s and 1970s created enormous enthusiasm in the professional community and played an important role in the rapid acceptance and use of functional appliances in the United States that has been largely ignored up till that time.

Activator

Norman Kingsley, an early influential American orthodontist, has been credited with the development of the first appliances to position the mandible forward as early as 1879. However, most consider Pierre Robin to have developed the earliest removable functional appliance, in fiance in 1902.

Hotz devised a "Vorbissplatte" which was a modified form of Kingsley's vulcanite palatal plate. This was used to treat retrognathism associated with deep bite.

Pierre Robin devised an appliance called Monobloc made up of a single block of vulcanite. He used it to position the mandible forward in patients with glossoptosis and severe mandibular retrognathism. By positioning the mandible forward; it reduced the risk of airway obstruction.

Viggo Andresen in 1908 **(Fig. 2.13)** in Denmark designed a loose filling appliance which he first used on his daughter. He made a modified Hawley type of retainer on the maxillary arch to which he added a lower lingual horse-shoe-shaped flange which helped in positioning the mandible forward. He used this appliance on his daughter who was going on a three month vacation. On her return three months later, he found a marked sagittal correction and improvement of the facial profile.

Although it was developed more than 70 years ago, the Andreson appliance, which is also known as an activator or monobloc, has been successfully used by generation of orthodontists. The thousands of cases from last 25 years, the activator is generally used in Vienna for the treatment of Class II Div I malocclusion.

During the time of Viggo Andresen and Haupl the appliances were made of vulcanized rubber, but this gave way to acrylic in the 1950s. Over the year, various modifications have been made to the original design of Andresen's appliance such as:

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Fig. 2.13: Viggo Andresen

1. The bow activator of AM Schwartz
2. Wunderer's modification
3. The propulsor
4. Cutout or palate free activator
5. The reduced activator or cybernator of Schmuth
6. Kawetzky modification
7. Herren's modification of the activator.

Most of the modifications of Andresen appliance were based on Andresen's concepts.There can be advantages to using a simple design in terms of patient co-operation, case of adjustment and freedom from breakages.

Graber observed that,

"Numerous modifications have been made to the Andresen–Haupl monobloc and have been described in texts and periodical contributions by Petrik, Eschler, Hoffer, Grossman and others. These are surprisingly effective at times but generally a simpler design of appliance is preferred."

Frankel Appliance

A more recent innovation in functional appliance design, the functional corrector or functional regulator or Frankel appliance was designed by Rolf Frankel in Germany and was introduced to orthodontics in 1966. This appliance was unique in that, it was principally tissue-borne, mostly supported in the vestibule rather than supported by teeth. There are five types of Frankel appliances and are used for management of Angle's class I, class II and class III malocclusions and even it is used in bimaxillary protrusion.

Bionator

The Bionator was developed in Germany by Wilhelm Balter in the early 1950s to increase patient's comfort and facilitate daytime wear to increase the functional use of the appliance. Balter accomplished this by drastically reducing acrylic bulk of the appliance. There are three types of bionators:

1. Standard bionator.
2. Class III or reverse bionator.
3. Open bite bionator.

Twin-block Appliance

Twin-block appliance is a functional jaw orthopedic appliance developed by Scottish orthodontist William Clark in the year 1977.

The twin-block appliance is composed of maxillary and mandibular retainers that fit tightly against the teeth, alveolus, and adjacent supporting structures. Delta clasps are used bilaterally to anchor the maxillary appliance to the first permanent molars and 0.030 inch ball clasps are placed in the interproximal areas anteriorly. The precise clasp configuration depends on the type of deciduous or permanent teeth and number of teeth present at the time of appliance construction.

Various designs are available for the lower part of the twin block appliance. The original design advocated by clark and it consists of a horse shoe of acrylic that extends anteriorly from the mesial of the first permanent molars.

The acrylic covers the lingual aspect of the premolar/deciduous molars and the canines and incisors. In this design delta clasps are used to anchor the appliance to the first premolar/first deciduous molar and ball clasp are present between the canines and lateral incisors, additional ball clasps can be placed between the incisors if appliance retention is thought to be a problem. There should not be any acrylic material touching the lower molars, this allows the lower molar to erupt vertically if the acrylic on the maxillary block is trimmed to increase the vertical dimension.

The twin block appliance has been shown to produce increase in mandibular length, incisor proclination and variations in lower anterior facial height.

The posterior bite blocks of the twin block appliance can be trimmed to facilitate the eruption of the lower posterior teeth in patient with a deep bite and an accentuated curve of Spee. The blocks also can be left untouched to prevent the eruption of the posterior teeth in patients with a tendency toward an anterior open bite.

Herbst Appliance

The Herbst bite jumping mechanism, was developed by Emil Herbst in the early 1900s. The original banded design of this appliance was introduced at the international dental congress in Berlin (Germany) by Herbst in 1905. It was introduced by Pancherz. Pancherz used a banded Herbst design that involved the:

- Placement of bands on molar and premolar in maxilla
- Bands are connected by copper lingual wire.
- Bands on lower right first premolar and lower right first premolar
- Bands are connected by a lower lingual arch wire

The Herbst appliance is a fixed functional orthopedic appliance having passive tube and plunger system with the exact length of the tube determining the amount of

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Table 2.9: Myofunctional/Functional orthodontic appliances

S. no	Types of appliance	Designed by	Year
1.	Activator	Viggo Andresen **(Fig. 2.13)**	1908
2.	Frankel appliance	Rolf Frankel	1966
3.	Bionator functional appliance	Wilhelm Balter	1950
4.	Jasper jumper	Joseper	
5.	Twin-block appliance	William Clark	1977
6.	Herbst appliance	Emil Herbst	1990
7.	Oral Screen	Newell	1912

Table 2.10: Fixed orthodontic techniques

S. no	Techniques	Formulated by
1.	E–Arch	Edward H Angle
2.	Pin and tube technique	Edward H Angle
3.	Edge wire technique	Edward H Angle
4.	Begg technique	PR Begg
5.	Straight wire technique	Lawrence F Andrew
6.	Lingual orthodontics	Cruz
7.	Invisalign technique	Zia Chrishti
8.	3D modular orthodontics	Wilson and Wilson

Table 2.11: Retainers

S. no	Types of retainer	Designed by
1.	Hawleys retainer	Hawleys
2.	Begg retainer	PR Begg
3.	Kesling tooth position	HD Kesling (1945)
4.	Invisible retainer	Osmu

anterior mandibular development. The tube is attached to a maxillary posterior tooth, whereas the plunger is fixed anteriorly to the mandibular dentition and slides through the tube during opening and closing movements.

Followings are the researchers involved in the development of various types of myofunctional appliances **(Table 2.9)**.

FIXED ORTHODONTIC TECHNIQUES

Fixed orthodontic appliance is an orthodontic device in which attachments are fixed to the teeth and forces are applied by arch wires or auxiliaries via these attachments. Various fixed orthodontic techniques are evolved over the years and followings are the researchers involved in the formulation of fixed orthodontic techniques **(Table 2.10)**.

RETENTION IN ORTHODONTICS

The term "retention" has been defined as "the holding of teeth in idealistic and functional positions" (Joondeph and Riedel, 1985). Followings are the researchers involved in the development of various types of retainers **(Table 2.11).**

Changes in the areas of orthodontic practice include a resurgence of treatment of the adult patients and its concomitant expertise as the public becomes aware of personal dental health and esthetics. Included also are the invasion of areas that had not received much attention in the past, namely, orthognathic surgery and the problems associated with the temporomandibular joint. Orthodontics has achieved the status of a recognized specialty of dentistry because of a long period of craftsmanship and professional expertise.

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EXAM-ORIENTED QUESTIONS

Long Essay or Long Questions

1. Define orthodontics and write in detail about history of orthodontics.
2. History of orthodontics
3. Angle's contribution to orthodontics
4. Tweed's contribution to orthodontics

Long Note or Short Essay

1. Orthodontics in 18th century
2. Orthodontics in 19th century
3. Orthodontics in 20th century.

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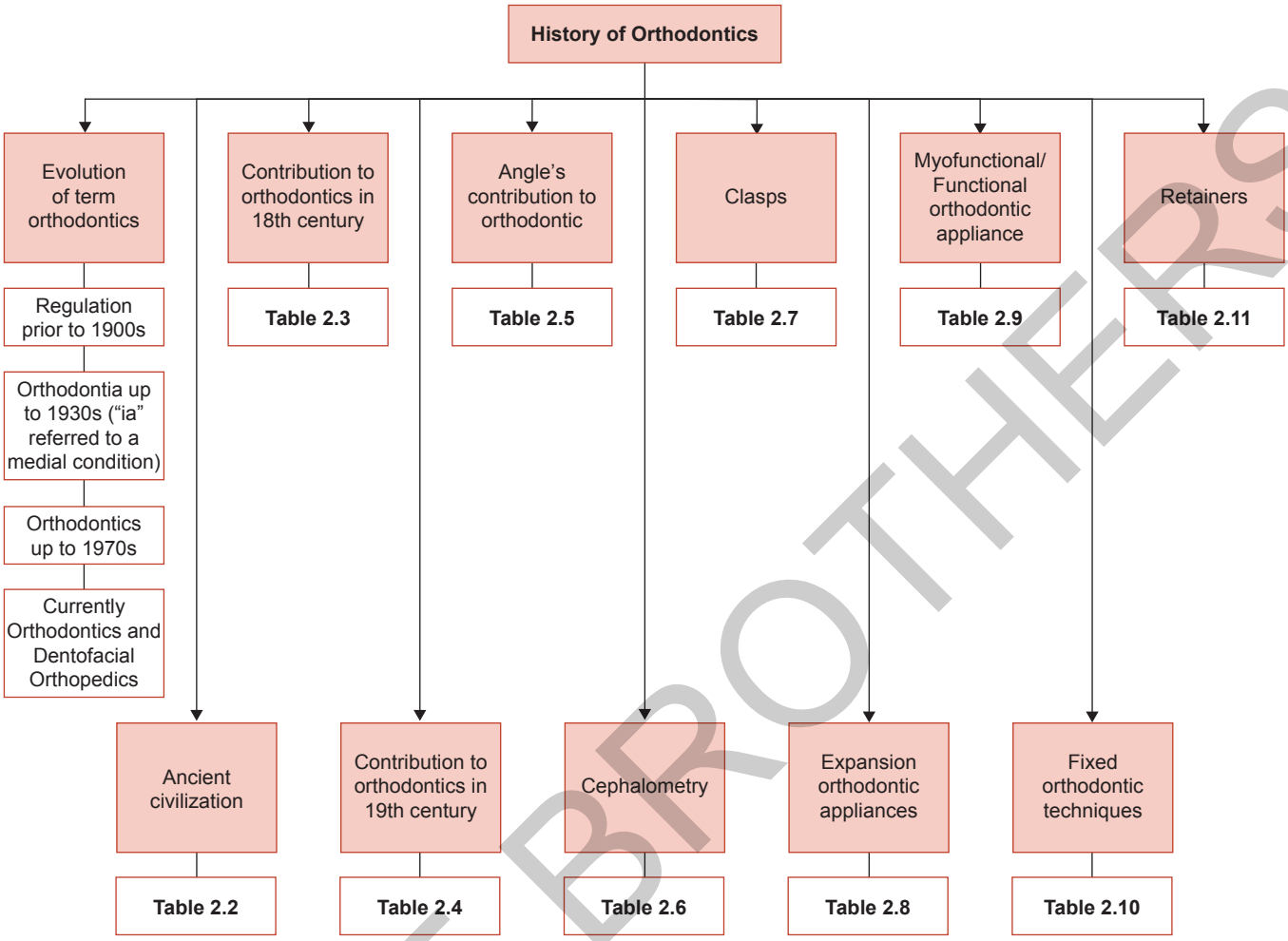
CHAPTER OVERVIEW



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Basavaraj Subhashchandra Phulari is a well known name in the field of Orthodontics has authored several reference titles including: *"An Atlas on Cephalometric Landmarks", "History of Orthodontic: A glance at exciting path the oldest speciality of dentistry has treaded", "A Clinical guide to Classifying malocclusions"* and *"Orthodontic Study Models"*. He also has a number of scientific articles published in several national and international journals to his credit.

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