History and Evolution of Orthodontics as a Science
Branch of dentistry concerned with prevention, interception and correction of malocclusion
Study of growth and development of jaws and face particularly and the body generally as influencing the position of teeth, the study of action and reaction of external and internal influences on the development and prevention and correction of arrested and perverted development.

[BSO-1922]
Unfavourable sequale of malocclusion

- Poor facial appearance
- Risks of caries
- Predisposition to periodontal diseases
- Psychological disturbances
- Risk of trauma
- Abnormalities of function
- Temporomandibular joint problems
Aims of orthodontic treatment

Summarized by Jackson as Jackson's triad

Functional efficiency
Structural balance
Esthetic harmony.
Scope of orthodontic treatment

Alteration in tooth position

Alteration in skeletal pattern

Alteration in soft tissue pattern.
Lefelon- coined the name orthodontics

In Greek ORTHOS-Correct
ONDONTOS- teeth
The history of orthodontics has been intimately interwoven with the history of dentistry for more than 2000 years. Dentistry, in turn, had its origins as a part of medicine.
To properly study our orthodontic origins, we must return to the Greek civilization of the pre-Christian era.
Greek physician Hippocrates (460 to 377 BC)

- revered as a pioneer in medical science
- first to separate medicine from fancy or religion.

With his reports of critical observation and experience, he established a medical tradition based on facts.

-collected information was gathered into a text known as the Corpus Hippocraticum, the medical testament of the preChristian era.
-does not discuss the dental art independently but contains many references to the teeth and the tissues of the jaws as part of the medical text. An example:

...the first teeth are formed by the nourishment of the fetus in the womb...the shedding of the first teeth generally takes place about seven years of age. ...teeth are disposed to irregularity, crowding one on the other and they are molested by headaches and otorrhea. (Epidemics, chapter: de carnibus.)
Aristotle (384 to 322 BC), the Greek philosopher, studied the teeth in a broad manner.

Marked differences between human teeth and those of animals and, in fact, differences between the different species of animals.

Described the dental apparatus of the viviparous animal, distinguishing between teeth, tusks, and horns.
MIDDLE AGES (476 to 1450AD)

There is very little reference to dentition during this period, with one exception, an Arabic physician, Paulus Aegineta (Paul of Aegina, 625 to 690), wrote:

*when supernumerary teeth cause an irregularity of dental arches, they may be corrected by resection of such teeth or by extraction.*
RENAISSANCE PERIOD (Fourteenth to sixteenth century)

During the Renaissance, one of the greatest geniuses of history, Leonardo da Vinci (1452 to 1519), is remembered because he painted a smile on the lips of Mona Lisa.

First artist to dissect the human body for the acquisition of anatomic knowledge and the first to draw accurate pictures of these dissections.

Made drawings of the number of teeth and their root formations.
Andreas Vesalius (1514 to 1564), a Belgian physician and anatomist

- set a precedent in the study of human anatomy when he personally performed a dissection.
...there are usually thirty-two teeth in all, a single series of sixteen in each jaw, most fittingly placed in the form of a semi-circle.

..... first four front teeth, because they cut, are called incisors;

.... next come the canines placed singly at each side, to have torn apart that not done by the incisors. They receive their name because of their resemblance to the outthrust of dogs.

...after them are the maxillares, or molars, five on each side, rough, broad, hard and large by means of which food cut by the incisors and broken up by the canines can be ground to perfect smoothness.
Bartholomaeus Eustachio (1520 to 1574), commonly known as Eustachius, also an Italian anatomist, described the minute structure of many organs, especially the tube that connects the middle ear with the nasopharynx and that bears his name.

He wrote Libellus de Dentibus (Book on the Teeth) in 1563, which gave the first accurate account of the phenomenon of the sequential development of the first and second dentitions.
His explanation of the internal structure of the teeth differentiated the two layers and compared the enamel with the bark of trees.

He also mentioned that the teeth are nourished differently than other bones, as witnessed by their inability to repair when fractured.
EIGHTEENTH CENTURY

France became the leader in dentistry throughout the world in the eighteenth century. This was primarily attributed to one man, 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."

Heralded the advent of the dental art based on fundamental knowledge.
With reference to orthodontics, as early as 1723, he developed what is probably the first orthodontic appliance. It was called a bandolet.

It was designed to expand the arch, particularly the anterior teeth and was the forerunner of the expansion arch of modern times.

Filing of teeth, especially for crowded anterior teeth.
Samuel S. Fitch, MD, whose book entitled *A System of Dental Surgery*, published in 1829, is considered the first to classify malocclusion:
The first when one central incisor is turned in, and the under teeth come before it, while the other central incisor keeps its proper place, standing before the under teeth.

The second is, when both the central incisors are turned in, and go behind the under teeth; but the lateral incisors are placed properly and stand out before the under teeth.

The third variety is when the central incisors are placed properly but the lateral incisors stand very much in; and when the mouth is shut, the under teeth project before them and keep them backward.

The fourth is, when all incisors of the upper are turned in, and those of the under jaw shut before them.
In 1860 Emerson C. Angell (1823 to 1903) was probably the first person to advocate the opening of the median suture to provide space in the maxillary arch.

As early as 1871 William E. Magill (1825 to 1896) was the first person to cement bands on the teeth for active tooth movement.
Norman W. Kingsley, a prominent dentist, artist, and orthodontist,

- first to use extra-oral force to correct protruding teeth.

- appliances for the correction of cleft palate

- associated with a technique known as jumping the bite with the use of a bite plate.
In 1880, Kingsley published “A Treatise on Oral Deformities”, which recommend that etiology, diagnosis, and treatment planning were the acceptable bases of practice.

"Much success in treating irregularities will depend upon a correct diagnosis and prognosis."
The most dominant, dynamic, and influential figure in the specialty of orthodontics was Edward H. Angle (1855-1930).
Through his leadership, orthodontics was separated from the other branches of dentistry (e.g., crown and bridge, prosthetics), and the result was the specialty of orthodontics.

Angle was the first to limit his practice to orthodontics.

He is regarded as the "Father of Modern Orthodontics."
Angle was born on June 1, 1855 in Herrick, Pennsylvania.

Graduated in 1878 from Pennsylvania college of Dentistry.

As he received his DDS degree from the Pennsylvania College of Dental Surgery, he was appointed to the chair of orthodontia in the Dental Department of the University of Minnesota.
His paper entitled "Notes on Orthodontia With a New System of Regulation and Retention." was presented at the ninth International Medical Congress (District of Columbia), which received wide attention.

In 1894 he was appointed the first professor of orthodontia at Marian Sims College, receiving the MD degree from that college the following year.
Angle organized the first school of orthodontia—The Angle School of Orthodontia. He placed the following advertisement:

“For the fitting of teachers and specialists in orthodontia. Two short sessions are held each year, beginning November 1 and May 1. Graduates in dentistry and only those thoroughly ethical, received. Class limited to fifteen members. For information, address Edward H. Angle, MD, DDS, 1107 North Grand Ave., St. Louis, Mo.33”
Angle stated that "the idea of a postgraduate school was forced upon me because I wished to see those who had a desire to study orthodontia better receive the opportunity to do so."

The course of instruction included art (taught by artist Edmund Wuerpel), rhinology, embryology, histology, comparative anatomy, and dental anatomy, in addition to his appliances.
Edward Angle published his "Classification of Malocclusion" in 1899 in the periodical, Dental Cosmos. He supplemented the information presented in this article in the publication in 1900 of the sixth edition of his book, ‘Treatment of the Teeth and Fractures of the Maxillae’. 
Angle developed a number of appliances like, E-Arch, the P IN & TUBE appliance, the RIBBON ARCH appliance and EDGE WISE appliance.

His ribbon arch bracket has been refurnished & re-vamped and now it is an integrated part of the Begg technique.
In 1906, Dr. Anna Hopkins, Angles' long-time secretary & dental graduate from University of Iowa became Mrs. Edward Hartley Angle.

Mrs. Angle did no formal teaching; Her gentle and understanding nature was in sharp contrast to the iron-handedness of her husband. Many students were saved from the brink of defeat by the kind encouragement of 'Mother Angle'.
Angle had an uncompromising position against extraction.

It was his credo that "the best balance, the best harmony, the best proportions of the mouth in its relation to the other features require that there shall be a full complement of teeth, and that each tooth shall be made to occupy its normal position—i.e., normal occlusion”.

The great controversy between Angle & Calvin Case about extraction -non extraction is a fascinating chapter in the history of orthodontics.
Their chief difference was in the indications and need for premolar extraction in the treatment of malocclusion, and the controversy was extensive, and bitter.
Angle in his sixth edition of book “Treatment of Malocclusion of Teeth & fractures of the Maxilla” wrote about cases in which the extraction of teeth was involved to solve orthodontic treatment problem.

But Angle dramatically changed his position when he became involved in a controversy with Calvin Case who advocates the use of extractions.
Perhaps he then decided to stress the non-extraction route coincidently at about the time his sixth edition was hitting the street and took it off the market.

So he published the seventh edition of his book not only had none of this material in it, but inveighed against the use of extractions.
Since Angle had a school for training orthodontists, his teaching style was unequivocally authoritarian; students were expected to follow his teachings without question, his philosophy of non extraction became the predominant one and the power accorded with him, none dared to say otherwise.
Angle died on August 11, 1930 in Santa Monica California

Though he died & his nature was unequivocally authoritarian, his influence is still felt very strongly in orthodontics

He is regarded as the most dominant, dynamic and influential figure in the specialty of orthodontics and even in the field of dentistry.

Even his enemies recognized the many contributions made by him.
Another distinguished orthodontist was Calvin S. Case (1847-1923).( Ohio College of Dental Surgery and the University of Michigan Medical School).

Case continued his interest in orthodontics, devising original appliances and the use of intermaxillary elastics.
He reintroduce the concept of removal of certain teeth that will enable the correction of malocclusion and improve general health and comfort that proved to be a "bombshell."
The extraction story was continued into 1911 with Martin Dewey (1881-1933) an ardent champion of nonextraction.

He had started his own graduate school in orthodontics in 1911 as the Kansas City School of Orthodontia.
The climax of this conflict was a debate in 1911 at the annual meeting of the National Dental Association (former name of the ADA).

Bitterness and animosity were rampant. It took many years after this episode for the problem to become a matter of calm and objective evaluation and respectful appreciation of various points of view, each of which has made its contribution to 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).
The second decade of 20th century is noted for several important advancements, namely, the serious study of tissue changes during orthodontic tooth movement by Albin Oppenheim (1911) and the beginning of a major interest in diet, nutrition, and genetics as reflected in orthodontic diagnosis.
Alfred Rogers (1873-1959) introduced the concept of myofunctional therapy (1918).

John V. Mershon (1867-1953) introduced the removable lingual arch based on the principle that teeth must be free and unrestricted for adaptation to normal growth.
Albert H. Ketcham (1870-1935), a devoted researcher, was one of the first to introduce the roentgenogram and photography into orthodontic practice.

He was regarded as a leader in orthodontics in the West and in his memory the American Association of Orthodontists has established the Ketcham Award to be given annually to a member in recognition of outstanding contributions to the specialty.
In 1931 B. Holly Broadbent published an article in the first issue of the new Angle Orthodontist entitled "A New X-ray Technique and Its Application to Orthodontia."

It was the introduction to the specialty and to dentistry of cephalometric roentgenography and, of course, cephalometric tracing and evaluation.
French orthodontist, Pierre Robin, had developed a new concept in 1902- the activator or monobloc.

It was reintroduced in 1932 by the Swedish orthodontist, V. Andreson, and was based on the concept that the musculature has a determining effect on growth of the dental apparatus.
In 1941, Charles H. Tweed (1895-1970) re-introduced into the literature an "edgewise" appliance, based on the basal bone concept.
William B. Downs (1899-1966) in 1948 introduced the cephalometric analysis that presented an objective method of portraying many factors underlying any malocclusion and that there could be a variety of causes of malocclusion exclusive of the teeth.
In the decade of 1970’s so many different types of appliances been introduced

Surveying the list, one could, if he were to shop at an "orthodontic shopping center," find among others the following appliances: a funktionregeler, or functional regulator (Fränkel); Balter's bionator; Bimler's activator; Swartz's double plate; Klammert's activator; Stockfisch's kinetor; Andreson's removable appliance.
The development of fixed lingual orthodontic appliances began in the mid-1970s, largely because of an increased interest in adult orthodontics.

These new "invisible braces" were designed in an effort to offer a valuable service to many patients who were unwilling to undergo treatment with labial appliances because of esthetic concerns.

During the past 10 years, various designs of lingual brackets have been used and frequently modified in an attempt to provide patient comfort, mechanical efficiency, and precise tooth positioning.
T.M. Graber (1917-2007) another great personality in orthodontics, learned more on the physiology of TMJ functions, cranio facial growth, on tissue changes incident with orthodontic tooth movement.

Willian R. Proffit
professor & chairman, Department of orthodontics in University of North Carolina School of Dentistry.

James L. Ackerman

Ackerman-Proffit system for classification of malocclusion involving 3 planes were put forward by Ackerman & Proffit.
Robert M. Rickets

Quad helix
Utility arch
Bio-progressive therapy
Rickets analysis
Growth studies and prediction
Computer in orthodontics
Dentofacial orthopedic appliances
Lawrence Andrews in 1970s introduced the six keys of occlusion.

Basics for the development of pre adjusted edge wise appliance

Various generations of PEA appliances.
“NEWER VISTAS IN ORTHODONTICS”
Technological advances have changed the face of every field in today's world.

Orthodontics, the first specialty of dentistry, which relies heavily on technology, is no exception.
Various innovations affect the contemporary orthodontic practice in different aspects of:

- Records keeping
- Diagnosis
- Treatment planning
- Treatment modalities
Digital Records
Electronic Dental Patient Record [EDPR]

- help us to automate our routine tasks of storing patient’s history, pertinent data from the clinical examinations, treatment records, diagnostic tests results, scheduling and financial management etc
DIGITAL MODELS

- Digital models make plaster models virtually obsolete

- Store, retrieve and diagnose cases

- ORTHOCAD and E-MODELS – two existing formats
Digital photographs

- Relatively cheap with high quality
- Instant result and verification
- Easy to keep – no space for storage
- Easy to use in presentations
- No ring flash needed
Wireless orthodontics

orthodontist- receive, diagnose, and determine a treatment plan from records transmitted to a handheld device over a wireless network
Digital cephalometry
- **DIRECT DIGITAL SYSTEM**
  
  - CCD SYSTEM
  - SP SYSTEM

- **INDIRECT DIGITAL SYSTEM**
Easy storage and retrieval
Lesser amount of time
Integration of cephalometric data with other datas
Easily present to patient
Errors of land mark identification can be reduced
“Vision is the art of seeing things invisible.”
Jonathan Swift (1667-1745)
Anatomic reconstruction
3D image rendered from lateral and frontal cephalograms using Acuscape sculptor
STEREOLITHOGRAPHY

Combining virtual reality and real virtuality
help us to enhance our ability to see our patients more dynamically and facilitate the quantification and communication of newer concepts of function and planning treatment of smile in 4 dimensions.
CUSTOMIZED PRESCRIPTIONS

Andrews-1972
  first generation- recommending a large range of bracket specification

Roth- 1976
  2nd generation-minimum extraction series brackets,

MBT versatile+Appliance system
  1990’s - 3rd generation

SureSmile*-individualized prescriptions
SureSmile is a technology-based Total Orthodontic Care Solution™

Provides the orthodontist with the ability to deliver truly customized care in a patient-centered practice
Minimize errors related to fixed appliance therapy with 3-D image capturing tools
Directly captures a three-dimensional image of the dentition in vivo.
Computer-based 3-D RX planning software

- to design customized orthodontic appliances
  on a virtual workbench in three-dimensional space
• precision bracket placement trays - result in effectiveness and efficiency of orthodontic care.
Automation technology to fabricate precision arch wires
FUNCTIONAL APPLIANCES

- TWIN BLOCK APPLIANCES
- FIXED FUNCTIONAL APPLIANCES
- MAGNETIC FUNCTIONAL APPLIANCES
INVISALIGN

Movement of teeth without the use of bands, brackets, or wires

Align Technology, Inc (Santa Clara, Calif),

(CAD-CAM) technology to fabricate a series of custom appliances that are esthetic and removable,
polyvinyl siloxane impressions, centric occlusion bite registration, OPG, lateral cephalographs.

Align Technology

Virtual gingiva placed along the gingival line of clinical crown to serve as the margin for manufacturing of the aligners.

VOT cut teeth allow them move separately
Orthodontist’s prescription followed in positioning the teeth and the bite to proper alignment virtually on the computer.

Tooth movements are staged so that there are no occlusal and interproximal interferences.

Number of stages necessary depends on the amount and complexity of the movement.
Orthodontist can check the proposed treatment on the Invisalign Web site.

Aligners will be manufactured after orthodontist approval so that movements seen on the computer screen can be transferred clinically to the patient.

Stereolithography machines, aligners.
New concept of “distracting the periodontal ligament” - proposed to elicit rapid canine retraction in 3 weeks.

Upper and lower canines were distracted bodily 6.5 mm into the extraction space within 3 weeks.

New alveolar bone was generated and remodelled rapidly in the mesial periodontal ligament of the canine during and after the distraction.
CONCLUSION
Orthodontics – the first branch of dentistry now of age more than 100 years if we accept advent of Angle school and teaching of E.H.Angle as beginning.

Technology is going to create wonders in this field.

Metallurgy will provide programmed arch wires, electronic and magnetic force system will complement and replace mechanical systems etc.
In this new millennium, it is time to look at the technologies that may help clinicians.

These technologies offer the potential to profoundly expand and deepen our understanding of growth, development and therapy.

But clinicians should evaluate these commercial marketing materials objectively and use them carefully to provide better patient care.

“CLINICIAN SHOULD BE IN THE DRIVERS SEAT”
Thank you