Adult
Orthodontics

Adult Orthodontics

- Adult orthodontic treatment is the one that is specially targeting post- adolescent patients.

- It also includes tooth movement carried out to facilitate other dental procedures necessary to control disease and restore function.

- Has been the fastest growing area in orthodontics in recent years.

Two groups of adult patients:

Young adults

- who desired but did not receive comprehensive orthodontic treatment as youths

Older Adults

- who have other dental problems receive adjunctive orthodontic treatment to make control of dental disease and restoration of missing teeth easier and more effective.

HISTORY OF ADULT ORTHODONTICS

Kingsley (1880) indicated an early awareness of the orthodontic potential for adult patients and stated that there are hardly any limits to the age when movement of teeth might not succeed.

- Differences between tooth movement in adolescent and older patients.
- Results become more and more doubtful with advancing years when a considerable number of teeth are to be moved

HISTORY OF ADULT ORTHODONTICS

MacDowell (1901) considered the age after 16 years as Impossible age.

- Believed complete and permanent change cannot be accomplished successfully except in cases of rare exceptions owing to

- development of the adult glenoid fossa
- the density of the bones
- less adaptability of muscles of mastication.

HISTORY OF ADULT ORTHODONTICS

- Lischer (1912) considered the period from the sixth to the fourteenth year i.e. time in an when a change from the temporary to the permanent dentition takes place as the Golden age of treatment.
- Case (1921) demonstrated the value of adult orthodontic therapy for patient with pyorrhea in the lower anterior area.

HISTORY OF ADULT ORTHODONTICS

Recently, a major reorientation of orthodontic thinking has occurred regarding adult patients. Because of the following reason :

1. Improved appliance placement techniques
2. More sophisticated and successful management of the symptoms associated with joint dysfunction.

HISTORY OF ADULT ORTHODONTICS

3.More effective management of skeletal jaw dysplasia's using advanced orthognathic surgical techniques

4.Increased desire of patients and restorative dentists for treatment of dental mutilation problems using tooth movement and fixed restorations rather than removable prosthesis.

Adult orthodontics

Adult orthodontics can mainly be divided into

Comprehensive treatment of adults

Adjunctive Treatment for Adults

Combined surgical and orthodontic treatment

Comprehensive treatment

- The boundary between adjunctive and comprehensive treatment is indistinct.

- Treatment that requires

• A complete fixed appliance

or

•That is complex enough to require more than 6 months for completion is considered comprehensive.

Comprehensive Treatment Plan

- The treatment plan is a prospective sequence of medical and dental procedures designed to alleviate the prioritized list of problems.

- For a favorable long-term prognosis, it is important to direct treatment at eliminating or at least controlling the etiology of the problems.

Alternate Treatment Plans

Constructed by arranging the teeth in a series of drawings that reflect the therapeutic options.

Way of communicating with patient regarding

- biologic considerations,
- treatment alternatives,
- potential compromises,
- probable consequences.

Adult orthodontic Treatment Objectives

The typical adolescent orthodontic treatment objectives

- dentofacial esthetics,
- stomatognathic function,
- stability ,
- static and dynamic Class I occlusion

often may not be realistic or necessary for all adult patients.

Adult orthodontic Treatment Objectives…..

- Treatment in which adolescent goals are not achieved is not necessarily compromised

- The mechanotherapy should satisfy the objective of providing the minimal dental manipulation appropriate for the individual case.

Adult orthodontic Treatment Objectives….

Adolescent treatment objectives including Class I occlusal goals can be considered overtreatment for patients who also require

- restorative dentistry,
- prosthetics,
- plastic surgery and
- other multidisciplinary dentofacial corrections

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

1. Parallelism of abutment teeth.
2. More favorable distribution of teeth.
3. Redistribution of occlusal and incisal forces.
4. Adequate embrasure space and proper tooth position.
5. Acceptable occlusal plane and potential for incisal guidance at satisfactory vertical dimension.

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES…

6. Adequate occlusal landmark relationships.
7. Better lip competency and support.
8. Improved crown/root ratio.
9. Improvement or self-correction of mucogingival and osseous defects.
10. Improvement and self-maintenance of periodontal health.

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES...

Parallelism of abutment teeth.

- The abutment teeth must be placed parallel with the other teeth to permit insertion of multiple unit replacement.

- For full-arch splints, the posterior teeth should be reasonably parallel to anterior abutments.

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES…

Parallelism of abutment teeth…

- Parallel abutments allow for better restorative retention
- A restoration will have a better prognosis if the abutment teeth are parallel before tooth preparation.

- Does not require excess cutting or devitalization during abutment preparation

- Allows for a better periodontal response.

More favorable distribution of teeth

- The teeth should be distributed evenly for placement of fixed and removable prostheses in the individual arches.
- Moving the teeth to act as favourable abutments can reduce the need for distal extension partial dentures or implants.
- They should be positioned so that occlusion of natural teeth can be established bilaterally between arches.

Redistribution of occlusal and incisal forces.

- Cases with significant bone loss require occlusal forces to be directed vertically along the long axis of the roots.
-
- Teeth can be moved orthodontically to more favourable positions.
- If posterior teeth are missing, anterior teeth can be positioned to allow favourable transfer of force and can then be reshaped to function as posterior teeth (supporting the vertical dimension).

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Adequate embrasure space and proper root position

Allows for better periodontal health, especially when the placement of restorations is necessary.

Anatomic relation of the roots is important in

- the pathogenesis of periodontal disease,
- interproximal cleaning,
- placement of restorative materials.

Acceptable occlusal plane and potential for incisal guidance at satisfactory vertical dimension.

- To establish the acceptable occlusal plane for a mutilated dentition exhibiting bite collapse, the Hawley bite plane is inserted with the platform of the anterior plane adjusted at a right angle to the long axis of the lower ncisors.

Acceptable occlusal plane and potential for incisal guidance at satisfactory vertical dimension.

- This allows a centric relation at an acceptable vertical relationship to be maintained, while

  - tooth alignment and
  - movement of the teeth to a more favorable position

to support the vertical dimensions and occlusal loading takes place.

Acceptable occlusal plane and potential for incisal guidance at satisfactory vertical dimension…

- If the vertical dimension is excessive patient may complain of muscle fatigue.
- However when properly adjusted at the correct vertical height, the bite plane will allow simultaneous bilateral neuromuscular activity.

Acceptable occlusal plane and potential for incisal guidance at satisfactory vertical dimension…

- If supraerupted molars are present,

- Most extruded posterior segment determines the potential for an orthodontic solution at an acceptable vertical dimension.

- The unilateral orthodontic treatment of an accentuated occlusal plane should be avoided; one side cannot be left extruded.

Acceptable occlusal plane and potential for incisal guidance at satisfactory vertical dimension…

- Adult molars with amalgam restorations and normal pulpal recession often can be occlusally reduced 2 to 4mm to achieve an acceptable occlusal plane level and still allow for placement of restorations without the need for devitalization.

Acceptable occlusal plane and potential for incisal guidance at satisfactory vertical dimension…

- In some of Class II, division I cases (when orthognathic surgery is rejected) the lower incisors can be advanced into a more procumbent position than the usual orthodontic norm to establish incisal guidance.

Acceptable occlusal plane and potential for incisal guidance at satisfactory vertical dimension…

- With the aid of bilateral posterior restorations, the incisors can be stabilized when in relatively flared positions (IMPA 105^0 to 120^0).
- In some Class III patients as well, the maxillary incisors can be kept in stable relation (even though more flared than normal) with posterior restorations.

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Adequate occlusal landmark relationships.

For adult patients, transverse dimension is most difficult to correct and maintain orthodontically, followed by sagittal and vertical.

•

•Posterior crossbites with severe transverse skeletal dysplasia, not to undergo surgery should be positioned so that maxillary buccal cusps contact the lower central fossae with crossover for incisal guidance in premolar area or canine positions

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Better lip competency and support.

- Many adults have long upper lips that preclude significant maxillary retraction.
- In such cases retraction is recommended to achieve lip competency while maintaining lip support.

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Better lip competency and support…

- Inadequate support may create a change of anteroposterior and vertical position of upper lip and increase wrinkling.
- This makes the face seem prematurely aged and is a major esthetic concern of adults.

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Improved crown/root ratio

- In adult patients who have lost bone on individual teeth, the ratio of crown to root can be improved by reducing the length of the clinical crown with the high-speed handpiece; as the tooth is erupted orthodontically.

- As the tooth erupts orthodontically the bone also follows the tooth so that the bone support is not compromised.

Improvement or correction of mucogingival and osseous defects…

- Proper repositioning of prominent teeth in the arch improves gingival topography.
- In adults the goal should be to level the crestal bone between adjacent cementoenamel junctions.
- This creates more physiologic osseous architecture with the potential to correct certain osseous defects.

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Improvement or correction of mucogingival and osseous defects…

Need for osseous and mucogingival surgery may be diminished by favorable tooth movement.

- During leveling stages, any teeth that have erupted above the occlusal plane should be grossly reduced occlusally; to prevent posterior premature contact and occlusal trauma, that can lead to bone loss or adverse changes in the supporting bony architecture.

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Better self-maintenance of periodontal health…

- Patients who need weekly periodontal maintenance during initial leveling phases of therapy may require less frequent scaling and root planning as periodontal status improves with tooth leveling and aligning.

- For better periodontal health, teeth should be positioned properly over their basal bone support.

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Better self-maintenance of periodontal health.

- The location of the gingival margin is determined by the axial inclination and alignment of the tooth.

- Clinically improved self-maintenance of periodontal health occurs with proper tooth position.

- Example: adult patients during correction of bite collapse and accelerated mesial drift

ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Better self-maintenance of periodontal health.

- In the nonsurgical management of skeletal Class III and Class II malocclusions, a delicate balance exists between periodontally desirable tooth positions and achievement of other nonsurgical treatment objectives.

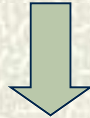
ADDITIONAL ORTHODONTIC TREATMENT OBJECTIVES

Esthetic and functional improvement.

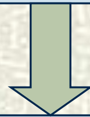
- The adult orthodontic treatment plan should provide acceptable dentofacial esthetics and allow for improved muscle function, normal speech, and masticatory improvements.
- This is possible when a therapeutic occlusion is provided that enables the posterior teeth to support the vertical dimensions.

Diagnosis and treatment planning

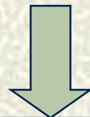
Collect data accurately



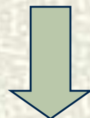
Analyze the data base



Develop problem list

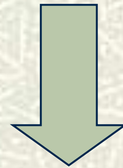


Prepare tentative treatment plan



Diagnosis and treatment planning…

Interact with those who are involved;
discuss plans and options
clarify sequence;
acquire patient acceptance



Create final treatment plan

Diagnosis and treatment planning…

Chief Complaint base of the "diagnostic tree"

- Gives an indication of the treatment expectations of the patient.
- Realistic treatment expectations are very important in cases of adult orthodontic treatment .

Psychological considerations

EXEPTIONAL PERSONALITY
HIGHLY SUCCESSFUL ,OVERCOMPENSATE FOR THEIR DEFORMITY

NO PROBLEM
REASONABLE TREATMENT EXPECTATIONS

INADEQUATE PERSONALITY
USES DEFORMITY AS SHIELD FOR WIDE RANGE OF SOCIAL ADJUSTMENT PROBLEMS

PATHOLOGICAL PERSONALITY
SMALL DEFORMITY, BIG PROBLEM
ALMOST IMPOSSIBLE TO HELP

Diagnosis and treatment planning…

Medical evaluation

- Genetic problems
- Acquired health problems
- Calcium metabolism and bone mass
- Medications
- Psychologic factors.

Diagnosis and treatment planning…

Clinical examination

Extraorally

- Frontal symmetry,
- Profile
- Lip protrusion and competence.

Diagnosis and treatment planning…

Intraoral examination

Soft tissue:

- Periodontium (inflammation and loss of attachment caused by pockets, recession, and bone loss)
- Pathologic condition of the mucosa
- Cancer screening.

Diagnosis and treatment planning…

Intraoral examination

Hard Tissues

The dentition should be evaluated for

- operative,
- endodontic, and
- prosthodontic problems.

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS

- The orthodontist must make an accurate assessment of the patient's potential for bone loss or gingival recession during orthodontic tooth movement.
- Tooth movement and clenching or grinding instigated by movement interferences, may lead to significant bone loss.

Diagnosis and treatment planning…
PERIODONTAL DIAGNOSIS…

- Regaining control of periodontal inflammation is harder than controlling it from the beginning.
- Every adult case should be closely monitored with the periodontal specialist.
- Appropriate management of several factors is needed to prevent negative periodontal sequelae during orthodontic treatment

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS…

These include:

1. Awareness and vigilance of the orthodontist and the staff.
2. Awareness and vigilance of the patient must be frequently reinforced.
3. Awareness of risk factors related to periodontal breakdown.

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS…

Risk factors

General Factors:

- Family history of premature tooth loss (indication of immune system deficiency in resistance to chronic bacterial infection associated with periodontal disease).
- General health status and evidence of chronic diseases (e.g. diabetes).

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS…

- Nutritional status
- Current stress factors
- Life stage of women

Local factors:

- Tooth alignment (e.g, marginal ridge, cementoenamel junction relationship).

Diagnosis and treatment planning…
PERIODONTAL DIAGNOSIS…

- Plaque indices
- Occlusal loading
- Crown-to-root ratio
- Grinding, clenching habits (parafucntional activity)
- Restorative status

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS…

CLASSIFICATION OF PERIODONTAL HEALTH OF ADULT PATIENTS

- Incipient periodontal disease
- Moderate periodontal disease
- Advanced periodontal disease

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS…

Incipient periodontal disease

Therapy prescribed

1. Scaling and curettage
2. Patient education for home care
3. 2 to 6 month maintenance intervals while in fixed appliances

Provider General dentist

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS…

Moderate periodontal disease

Therapy prescribed

1. Scaling
2. Curettage and periodontal surgery 6 to 8 weeks before orthodontics
3. Orthodontic tooth movement

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS…

4. 4 to 16 week maintenance intervals during orthodontic treatment
5. Periodntal reevaluation 12 weeks after appliances are removed.

Provider

Periodontist and Orthodontist

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS…

Advanced periodontal disease

Therapy prescribed

1. Scaling
2. Periodontal curettage(open-flap-clean-out)
3. Orthodontics
4. Periodontal reevaluation
5. Definitive osseous surgery

Diagnosis and treatment planning…

PERIODONTAL DIAGNOSIS…

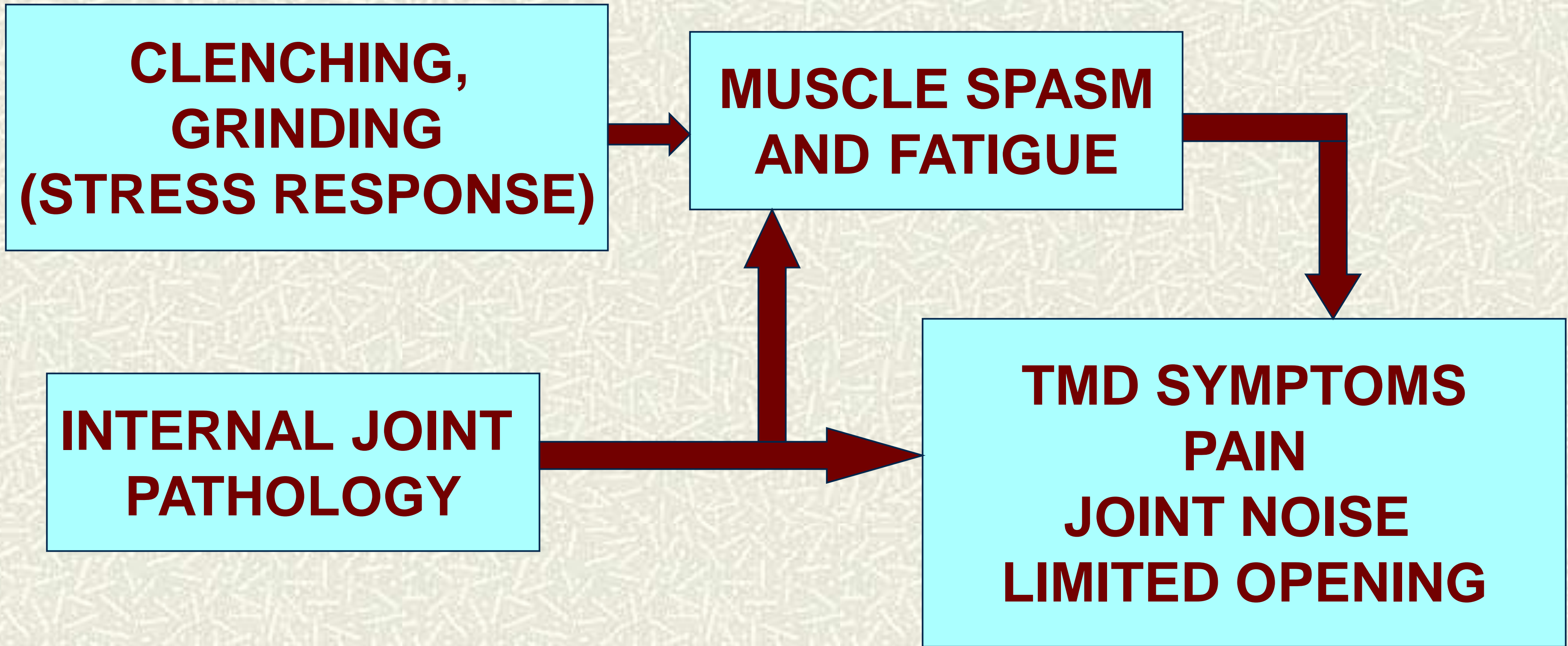
6. Final restorative dentistry
7. Periodontal consideration reevaluated- This is done clinically with radiographs; check mobility,perform probing and make soft tissue assessment.

Provider Periodontist, orthodontist, general dentist

DIAGNOSIS OF TEMPOROMANDIBULAR JOINT DYSFUNCTIONS

- The signs and symptoms of TMD often increase in frequency and severity during adult treatment.
- Thus, it is imperative that orthodontists should diagnose any TMD present and determine its etiology before starting the orthodontic treatment.

TMJ considerations



Diagnosis and treatment planning…
Diagnostic records

A complete set of diagnostic records should be obtained including

- Casts
- Radiographs
  - IOPA
  - Panoramic
  - Cephalograms (optional)
- Photographs

Diagnosis and treatment planning…

Evaluation of the malocclusion.

Etiology of malocclusion.

- In the absence of congenital anomalies or significant trauma most people with a full complement of teeth have the genetic potential to develop and maintain a normal occlusion.
- Thus, the main environmental factors causing malocclusions are:

Diagnosis and treatment planning…

- habits
- functional compromises
- soft tissue posture
- developmental aberrations and trauma
- periodontal disease
- caries

Diagnosis and treatment planning…

- Cause of the malocclusion should be carefully considered
- Treatment should be directed at eliminating or controlling the aberrant factors.
- ***Thus, th***e diagnosis is a prioritized list of problems based on a careful evaluation of entire database.

Treatment Planning comparisons between adolescent and adult orthodontic patients

- A through understating of the similarities and difference between adolescent and adult patient is required to develop a less stereotyped and more customized treatment plan for adult patients.
- Several authors have identified what they consider the major differences between adolescent and adult patient

Treatment Planning Diagnostic between adolescent and adult orthodontic patients…

- Leavitt (1971): in adult patient there is no growth only tooth movement
- Barrer (1977): stated that the adult unlike the child is a relentless patient who will not cover our deficiencies in skill or our errors in the use of mechanical procedures by helpful setling in post treatment.

Treatment Planning Diagnostic between adolescent and adult orthodontic patients…

- Ackerman(1978) stated

For a child patient one occasionally calls another specialist. On the other hand it is a rare adult whom one treats orthodontically without finding it necessary to collaborate with another specialist.

FACTORS IN SELECTION OF A TREATMENT PLAN :COMPARISON BETWEEN ADOLESCENT AND ADULT

A. **Growth factors**

B. **Existing oral pathosis**

1. Dental caries
2. Periodontal disease
3. Faulty restorations
4. TMJ adaptability
5. Occlusal interferences
6. Dental mutilation

FACTORS IN SELECTION OF A TREATMENT PLAN :COMPARISON BETWEEN ADOLESCENT AND ADULT

C. Biological considerations

1. Neuromuscular maturity
2. Rate of tooth movement
3. Periodontal susceptibility

D. Dentofacial esthetics

FACTORS IN SELECTION OF A TREATMENT PLAN :COMPARISON BETWEEN ADOLESCENT AND ADULT

E. Therapeutic approaches available

1. Orthopedics
2. Orthognathic surgery
3. Restorative dentistry
4. Combination treatment
5. Extraction controversy
6. Anchorage potential

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Growth factors

Adolescents

- Because of growth an orthopedic option is available.; stable correction of skeletal discrepancy is possible.
- Sequence of difficulty of orthodontic correction(most to least) is vertical , anteroposterior, transverse.

COMPARISON BETWEEN ADOLESCENT AND ADULT...

Growth factors…

Adults

- No growth with minimal skeletal adaptability; therefore surgical procedures are necessary for moderate to severe skeletal disharmonies;
- stable correction in skeletal transverse problems requires surgically assisted rapid palatal expansion.

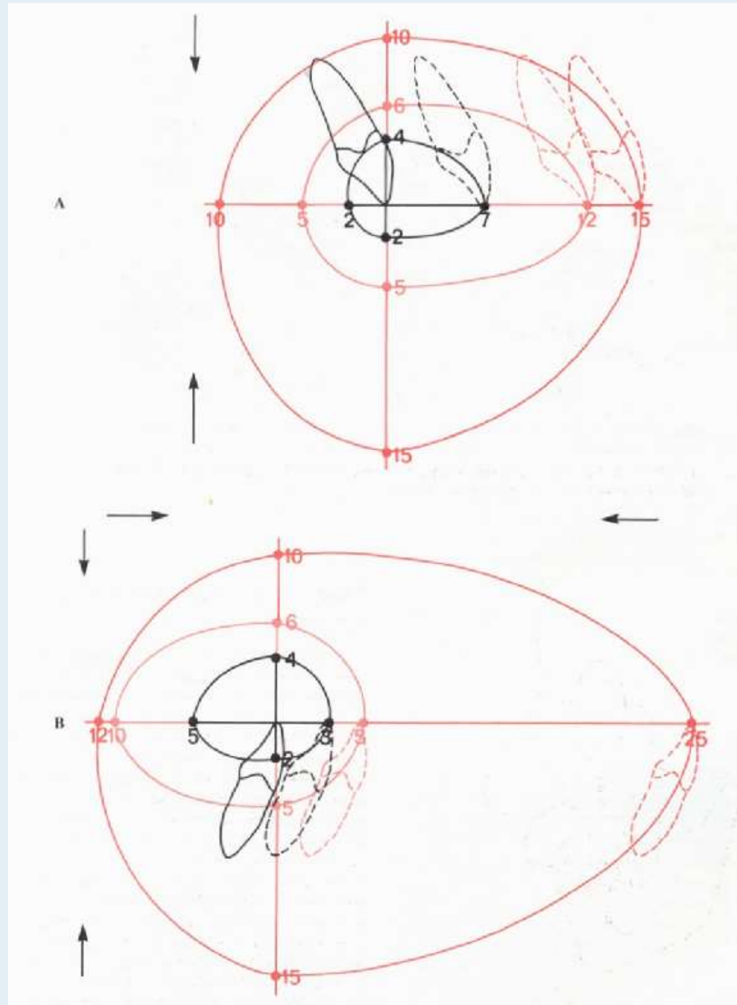
Growth factors…

Adults…

- Mandibular deficiency : sagittal split osteotomy and mandibular advancement;
- Mandibular excess : mandibular setback;
- Vertical maxillary excess with or without open bite : Lefort osteotomy.
- Combination problems may require combination surgery depending on severity

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Growth factors…



FACTORS IN SELECTION OF A TREATMENT PLAN :COMPARISON BETWEEN ADOLESCENT AND ADULT

Existing oral pathosis

Dental caries

Adolescents More likely to have simple carious lesions, but more susceptible to caries

Adults More likely to have recurrent decay, restorative failures, root decay, and pulpal pathosis.

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Existing oral pathosis…

Periodontal disease

Adolescents

More resistant to bone loss, but highly susceptible to gingival inflammation

Adults

Higher susceptibility to periodontal bone loss.

COMPARISON BETWEEN ADOLESCENT AND ADULT...

Existing oral pathosis…

Faulty restorations

Adolescents

Few significant restorative problems

Adults

Frequent restorative problems with economic and treatment planning implications

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Existing oral pathosis…

TMJ adaptability

Adolescents

Small percentage with symptoms because of high degree of TmJ adaptability; infrequent symptoms

Adults

Frequent appearance of symptoms with dysfunction

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Existing oral pathosis…

Occlusal interferences

Adolescents

Infrequent cause of problem

Adults

Hightened ; may lead to accelerated enamel wear with adverse change in supporting tissues.

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Dentofacial esthetics

Adolescents

Reasonable concern frequently matched to severity of condition

Adults

Concern occasionally disproportionate to degree of existing problem

Biological considerations

Neuromuscular maturity

Adolescents Significant potential for adaptability of stomatognathic system, allowing a variety of biomechanical choices (class II elastics)

Adults mechanical options are limited because of lack of neuromuscular adaptability

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Rate of tooth movement

Adolescents

Predictable and rapid, particularly during eruptive stages when permanent root development is not yet completed

Adults

somewhat slower

Periodontal susceptibility

Adolescents more resistant to bone loss as a result of periodontal disease

- but highly susceptible to gingival inflamation.

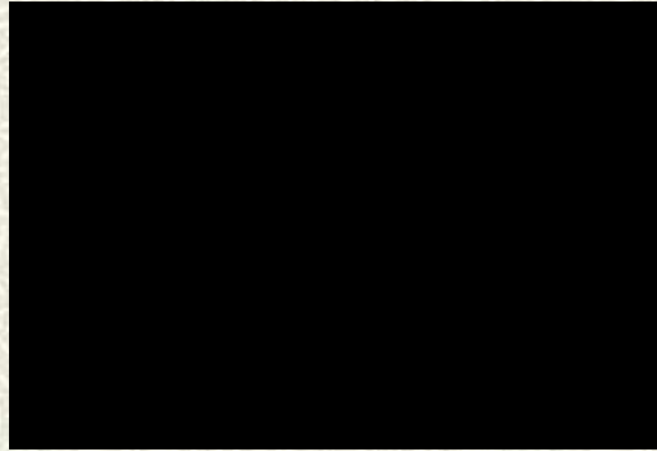
Adults Higher degree of susceptibility to bone loss as a result of periodontal disease,

- particularly evident during orthodontic therapy may need modification of mechanotherapy

Effects of reduced periodontal support

- When bone has been lost same amount of force produces greater pressure in PDL of a compromised tooth than a normally supported one.
- Greater the loss of attachment, smaller the area of supported root and further apically the center of resistance

Effects of reduced periodontal support



The center of resistance of a single rooted tooth is approx. one tenth the distance between apex and crest of bone. In periodontally compromised patient there is reduction in bone level and hence the center of resistance shifts apically.

Effects of reduced periodontal support…

- This affects moments created by forces applied to the crown and moments needed to control root movement.
- Lighter force and larger moments are needed in such cases.

Gingival esthetic problems

These are created by

1. Uneven display of gingiva

e.g. substituting a canine for missing lateral incisor

- Elongating a tooth to compensate for broken incisal edge .
- Better to restore the incisal edge by composite.

Gingival esthetic problems

2. Gingival recession after periodontal loss

- Creates black holes between the maxillary incisors
- Remove interproximal enamel so that the incisors can be brought closer together.
- This moves the contacts gingivally minimizing the open space between the teeth.

Therapeutic approaches available…

Dental mutilation

Adolescents early treatment control during eruptive stages facilitate space closure without prosthesis

- e.g, congenitally missing maxillary laterals or missing second premolars.

Adults present with a number of missing teeth.

- More difficult to treat without prosthesis and restorations.

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Therapeutic approaches available

Orthopedics

Adolescents About half require orthopedics

Adults Effective only in small percentage

Orthognathic surgery

Adolescents Major skeletal alterations needed in 1 to 5%

Adults major alterations needed in 10 to20%

Therapeutic approaches available…

Restorative dentistry

Adolescents

- Smaller percentage requires it,
- when teeth are congenitally missing
- frequently orthodontic therapy is useful in space closure or space redistribution, thus avoiding the need for restorative dentistry.

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Therapeutic approaches available…

Restorative dentistry…

Adults

- Integrated restorative plan can greatly reduce duration of fixed appliance treatment
- Frequently required for space reopening where teeth have been lost and
- for abutment preperation and stabilization of occlusal relationship;

Therapeutic approaches available…

Combination treatment

Adolescents Uncommon

Adults Required in 80% of cases

Extraction controversy

Adolescents a treatment plan of four premolar extraction is used frequently to resolve crowding and protrusions,

space gaining techniques are also available.

Therapeutic approaches available…

Extraction vs nonextraction therapy

Adults

- Four premolar extractions are used less frequently to resolve crowding, upper premolar extractions are a common alternative ,
- asymmetric extraction and
- stripping of over bulked restorations.

Therapeutic approaches available…

Strategic extractions

Adults Irreversible damage to periodontal tissues or to adjacent teeth may force orthodontists into unusual treatment plans for adults,

- Careful analysis may lead to strategic extraction to solve alignment problems, as well as to eliminate existing damaged teeth.

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Therapeutic approaches available…

Anchorage potential

Adolescent more frequent incorporation of headgear to maximize anchorage and retraction of the anterior teeth.

- Headgear cooperation Greater

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Therapeutic approaches available…

Adults

- fewer adult cases will be categorized as maximal anchorage problems,
- implants in conjunction with restorative dentistry ,
- several molar distalization techniques are being developed as options to avoid headgear wear with adults.

COMPARISON BETWEEN ADOLESCENT AND ADULT…

Therapeutic approaches available…

Adults

- Frequent problems involving anterior and posterior teeth require restorative commitment for treatment planning
- supraeruption is a problem in posterior bite collapse,
- Occlusal plane management is crucial.

Sequence of treatment

It can be given in the following steps

Comprehensive treatment plan

Stage 1: disease control

Stage 2: reestablish occlusion

Stage 3: definitive periodontic or restorative procedures.

Stage 4. : maintenance

COMPLICATIONS IN ADULT ORTHODONTIC TREATMENT

Medical Concerns

- The medical history should be updated regularly.
- If significant medical problems occur, confer with the patient’s physician regarding continuing or interrupting orthodontic treatment.

Medical Concerns…

- Some problems e.g. recent myocardial infarction may require interrupting or terminating all elective care.
- Thus, careful monitoring of medical factors is essential for effective management of adult patients during adjunctive orthodontic treatment or as part of a comprehensive multidisciplinary treatment plan.

COMPLICATIONS IN ADULT ORTHODONTIC TREATMENT…

Poor Cooperation

- Treatment with fixed mechanics is contraindicated until the patient has demonstrated the ability to maintain good oral hygiene.
- Oral hygiene and the periodontal condition should be monitored at each appointment.

Caries

Incipient and undiagnosed caries in course of treatment can lead to compromises in orthodontic results.

- No previous caries Panoramic radiograph only
- Previous caries Obvious pathology

  Add bitewing radiographs
- Deep caries Add periapical radiographs

Technical Problems

- Panoramic radiographs and intraoral radiographs should be taken at every 6-months and cephalometric radiographs should be taken every 12 months.

- Superimpositions of tracings for identifyuing complications and determining if the treatment can progress as planned.

COMPLICATIONS IN ADULT ORTHODONTIC TREATMENT…

Temporomandibular disorders

For a minor problem there may be no need for specific dental treatment.

Treatment includes

- Identifying the bad habit and eliminating it.
- Rest with limited function
- Reassurance

If there is a clear relationship of symptoms to orthodontic changes in occlusion, the orthodontic treatment should be considered.

Segmented arch technique in adults

- Helpful in controlling the force magnitude in adults as it involves creating a stable anchorage unit consisting of several teeth connected to act as a single multirooted teeth so the force is distributed over a larger area.

- This is more important in periodontally compromised cases.

Finishing and retention

- Positioners are rarely indicated as finishing devices in adult patients with periodontal disease.
- In patients having significant bone loss and tooth mobility, both short term and long term splinting is required.
- Treatment is finished with archwires and then stabilized immediately with retainers.

Adjunctive Treatment for Adults

Tooth movement carried out to facilitate other dental procedures necessary to control disease and restore function.

- Limited orthodontic goals.
- Improving a particular aspect of the occlusion rather than comprehensively altering it.
- Appliances required in only a portion of dental arch and for only a short time.

Adjunctive orthodontic treatment involves

1. Repositioning (uprighting) teeth that have drifted after extractions or bone loss.
2. Forced eruption of badly broken down teeth to expose sound root structure on which to place crowns.
3. Alignment of anterior teeth for more esthetic restorations while maintaining good interproximal bone contour and embrasure form.

The Goals of Adjunct Treatment

- To facilitate restorative treatment by positioning the teeth so that more ideal and conservative techniques can be used.
- To improve the periodontal health by eliminating plaque harboring areas
- To establish favorable crown-to-root ratios
- Position the teeth so that occlusal forces are transmitted along the long axes of the teeth.

Biomechanical considerations in adjunctive procedures

The appliance used can be either

- **Removable**
- **Fixed**

Removable appliances

Advantages

- Permit reactionary forces to be spread over adjacent supporting tissues such as palatal vault.

Disadvantage

- Control of root positions is difficult
- Worn part time
- Intermittent forces though capable of producing tooth movement are not as efficient as continuous forces.

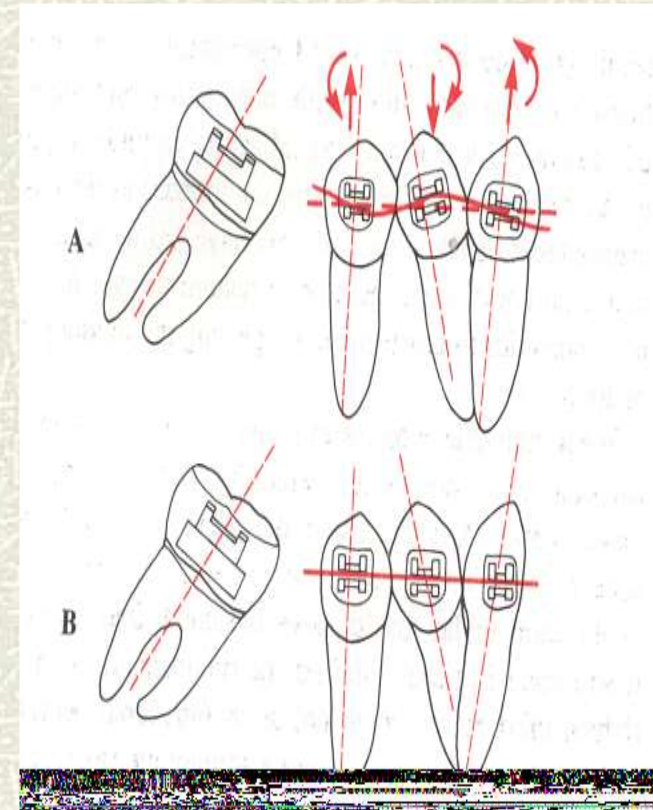
Fixed appliances

- Fixed appliances are considered more suitable
- Straight wire brackets are designed for a specific location on an individual tooth.
- With the brackets in this position, a rectangular wire bent to ideal arch form if deflected and fully engaged into the bracket slot, would produce a force system to move the teeth into an ideal relationship.

Fixed appliances…

- In a partial fixed appliance the brackets are placed in an ideal position only on teeth to be moved,

- The remaining teeth should be incorporated in the anchor system are and bracketed so that the archwire slots are closely aligned.



Adjunctive Treatment Procedures

- Uprighting Posterior Teeth
- Forced eruption of teeth
- Alignment of anterior teeth

Uprighting Posterior Teeth

Treatment Planning Considerations.

- When a posterior tooth is lost, the adjacent teeth usually tip, drift and rotate.

- As the teeth move, the adjacent gingival tissue becomes folded and distorted, forming a plaque-harboring pseudopocket.

•Additional periodontal damage also can occur as a result of misdirected occlusal forces.

Uprighting Posterior Teeth…

- The elimination of potentially pathologic conditions associated with tipped molars is the most important procedure in adjunctive orthodontic treatment
- It has the added advantage of simplifying the restorative procedures.

Consideration while Molar Uprighting…

If the third molar is present

Distal positioning of the third molar can move this tooth into a position

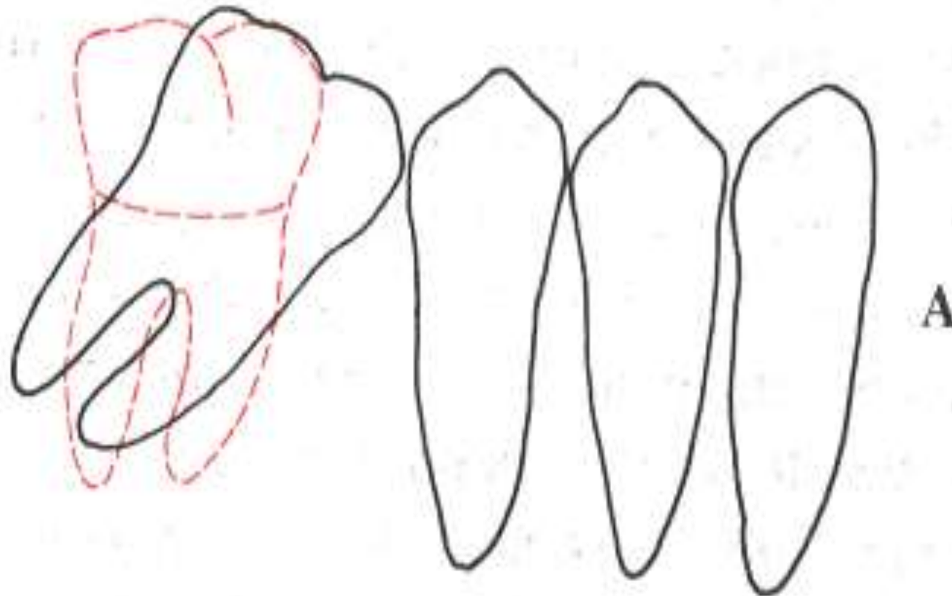
- where good hygiene could not be maintained,
- or the up- righted third molar would not be in functional occlusion.

In these circumstances, it is more appropriate to extract the third molar and simply upright the remaining second molar tooth.

Consideration while Molar Uprighting…

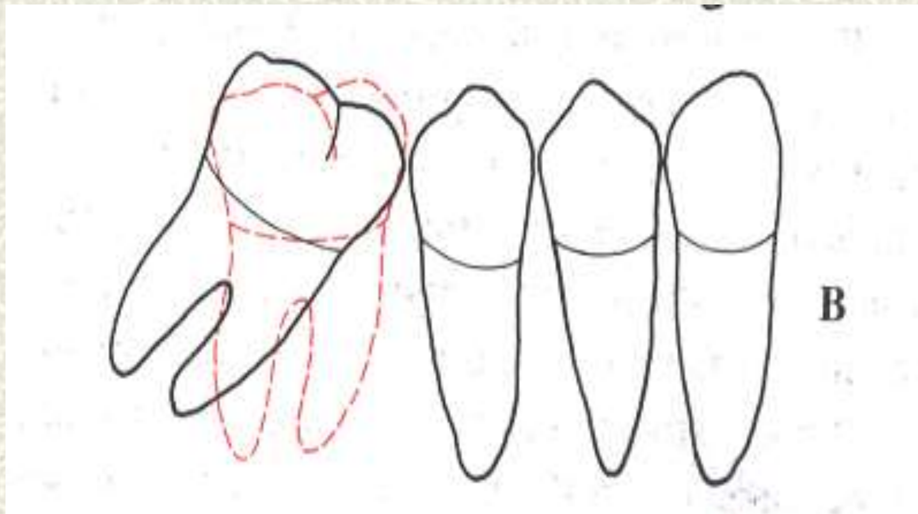
Whether to upright the tipped teeth

- by distal crown movement (tipping) to increase the space for a later pontic.



Consideration while Molar Uprighting…

- by mesial root movement, to maintain or reduce the edentulous span or even close the extraction space, thereby eliminating the need for a bridge



Consideration while Molar Uprighting…

Distal crown tipping for uprighting molars is preferred over mesial root movement

- Individuals who need molar uprighting generally have lost their first molars many years previously, and ridge resorption usually has occurred.

- Total space closure for these patients is almost impossible to achieve and maintain.

Consideration while Molar Uprighting…

Whether slight extrusion of the tooth is permissible or maintenance of the existing ouclusal height is required as the uprighting occurs.

- Tipping the tooth distally generally extrudes it.
- This has the merit of reducing the depth of the pseudopocket found on the mesial surface

Consideration while Molar Uprighting…

- While the mucogingival junction remains stable, it also increases the width of the keratinized tissue in the area.

- In addition, if the height of the clinical crown is systematically reduced as uprighting proceeds the ultimate crown-root length ratios will be improved .

Consideration while Molar Uprighting…

- Maintaining the existing occlusal level as the tooth uprights may require actual intrusion, which would increase the pocket depth and of relocate infected crevicular tissue further subgingivally
- Moreover, intrusion of molars is technically difficult, requiring precisely directed and gentle long-acting forces

Consideration while Molar Uprighting…

Whether the premolars should be repositioned as part of the treatment.

- ❖ depends on the position of these teeth, the existing contacts, the opposing intercuspation, and the restorative plan.
- ❖ It is particularly desirable to close spaces between premolars when uprighting molars, because this will improve the long-term stability.

Appliances for Molar Uprighting.

Appliance can be separated into

an active and

a reactive (stabilizing or anchor) unit.

To provide anchorage all teeth as far forward as the canine in the treatment quadrant should be included.

Canine on contralateral side should be linked to the anchor teeth by stabilizing lingual arch.

Attachment for the molar(s) to be uprighted Banded or Bonded

Bonded:

- more likely to fail because of the difficulty in moisture control in the molar region
- occlusal forces against the molar attachment may be heavy.

Banded

- gingival irritation is greater with bands than bonded attachments.
- molar bands are best when the periodontal condition allows.

Orthodontic Technique:
for molar uprighting

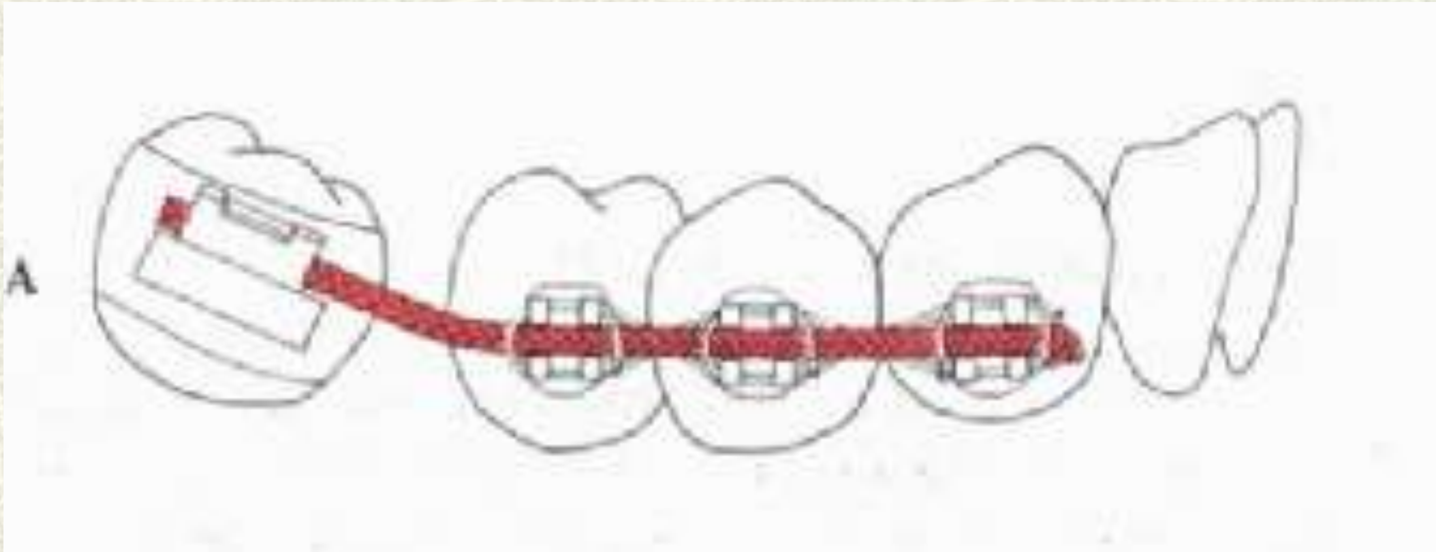
Uprighting a Single Molar

Distal Crown Tippping with 0cclusal Antagonist.

Any initial alignment is accomplished with a flexible rectangular wire such as 17 x 25 braided stainless steel or 17 X 25 NiTi.

Orthodontic Technique:
for molar uprighting

If wire can be placed in brackets without permanent distortion, molar uprighting will begin and a single wire can complete the necessary uprighting.



Orthodontic Technique:
for molar uprighting

From the placement of the initial wire occlusal contacts against the molar should be relieved.

Failure to relieve the occlusion

- prevents it from tipping upright,
- greatly slows the desired tooth movement, and
- may cause excessive tooth mobility.

Orthodontic Technique:
for molar uprighting

Severely tipped molar

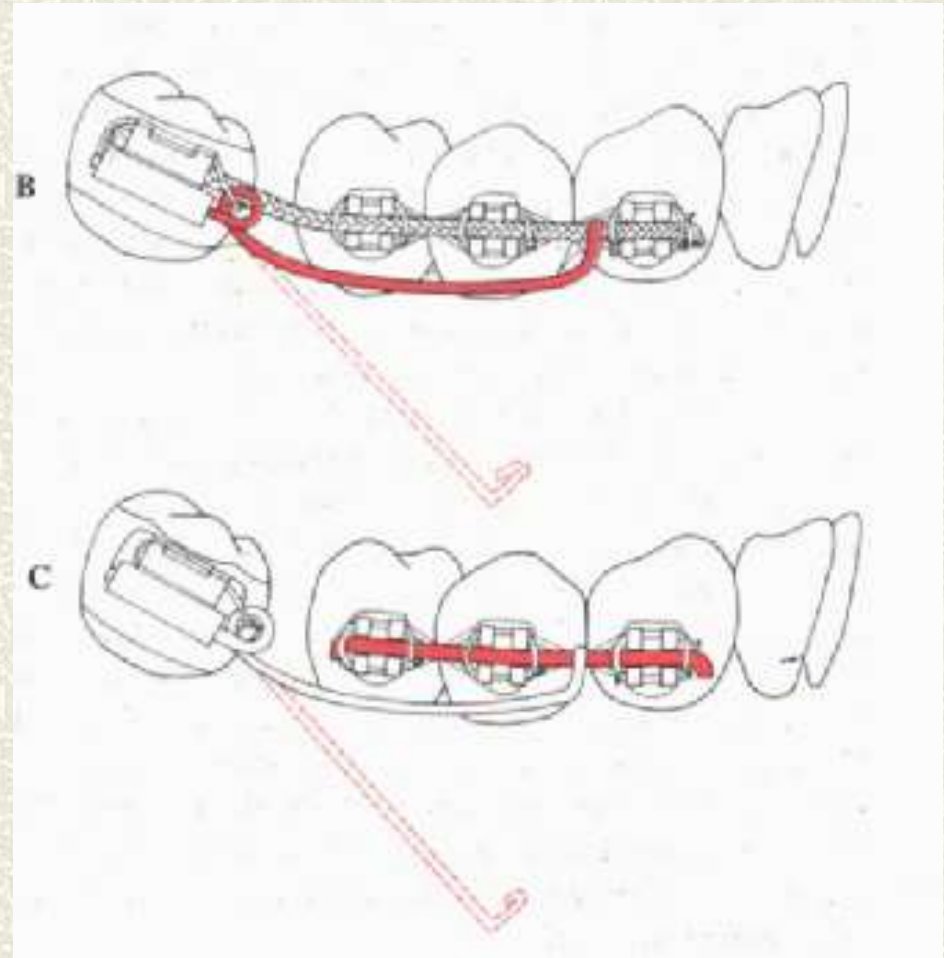
sectional ***uprighting spring***.

- A stiff rectangular wire (19 X 25 steel) maintains the relationship of teeth in anchor segment
- The uprighting spring is formed from either 17 X 25 beta-Ti wire without a helical loop, or 17 X 25 steel wire with a loop to reduce the force level and placed in the molar auxiliary tube.

Orthodontic Technique:

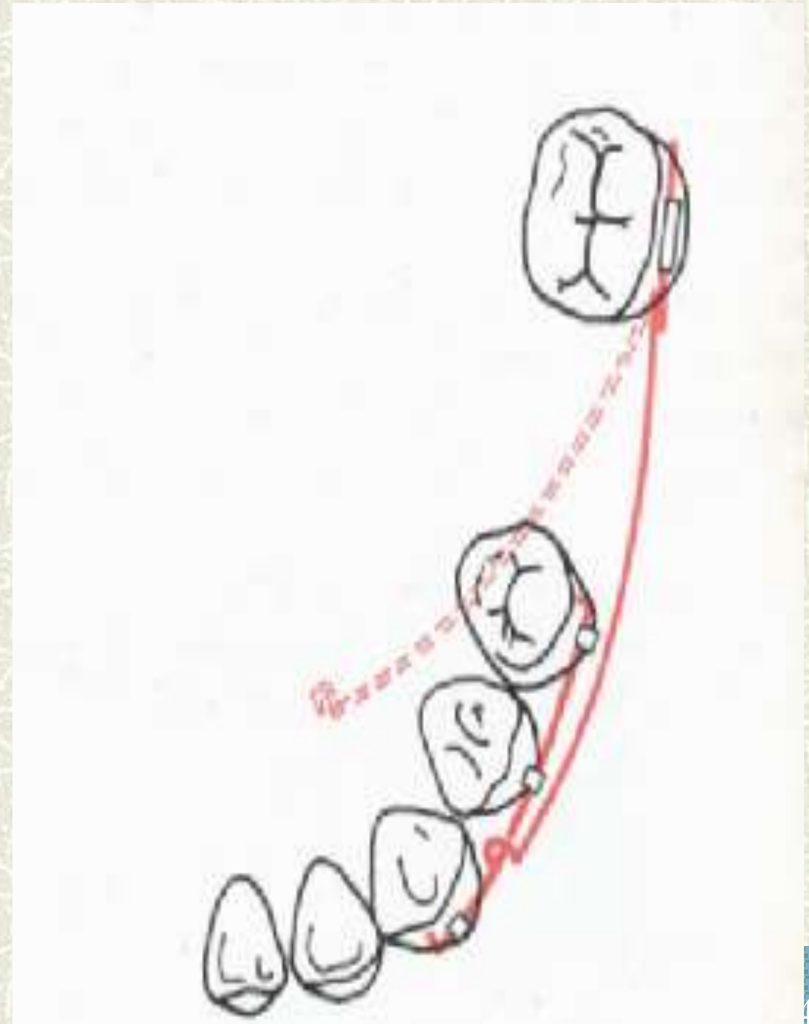
for molar uprighting

- The mesial arm of the helical spring is adjusted to lie passively in the vestibule and upon activation is hooked over the archwire in the stabilizing segment.



Orthodontic Technique:
for molar uprighting

- A slight lingual bend placed in the up- righting spring is needed to counteract the forces that tend to tip the anchor teeth buccally and molars lingually.



Orthodontic Technique:
for molar uprighting

- This technique results in considerable occlusal as well as distal crown movement,
- Rapidly extrudes an unopposed terminal molar.
- Used only when terminal molar has an occlusal antagonist.

Orthodontic Technique:
for molar uprighting

Uprighting Without Extrusion.

This is required:

- If the molar to be up- righted has no occlusal antagonist,
- If extrusion is undesirable, or
- If the crown is to be maintained in position while the roots are brought mesially

Orthodontic Technique:
for molar uprighting

An alternative uprighting approach used –

After initial alignment of the anchor teeth with a light flexible wire, a single " T-loop" sectional archwire of

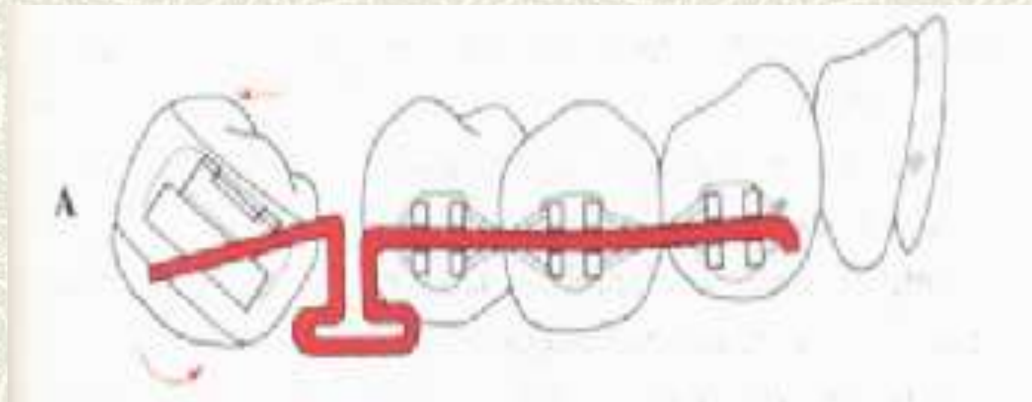
17 X 25 stainless steel or

19 X 25 b- Ti is placed to fit passively into the brackets on the anchor teeth and gabled at the T to exert an uprighting force on the molar.

.

Orthodontic Technique:
for molar uprighting

When engaged in the molar bracket, this wire will thrust the roots mesially while the crown tips distally.



Orthodontic Technique:

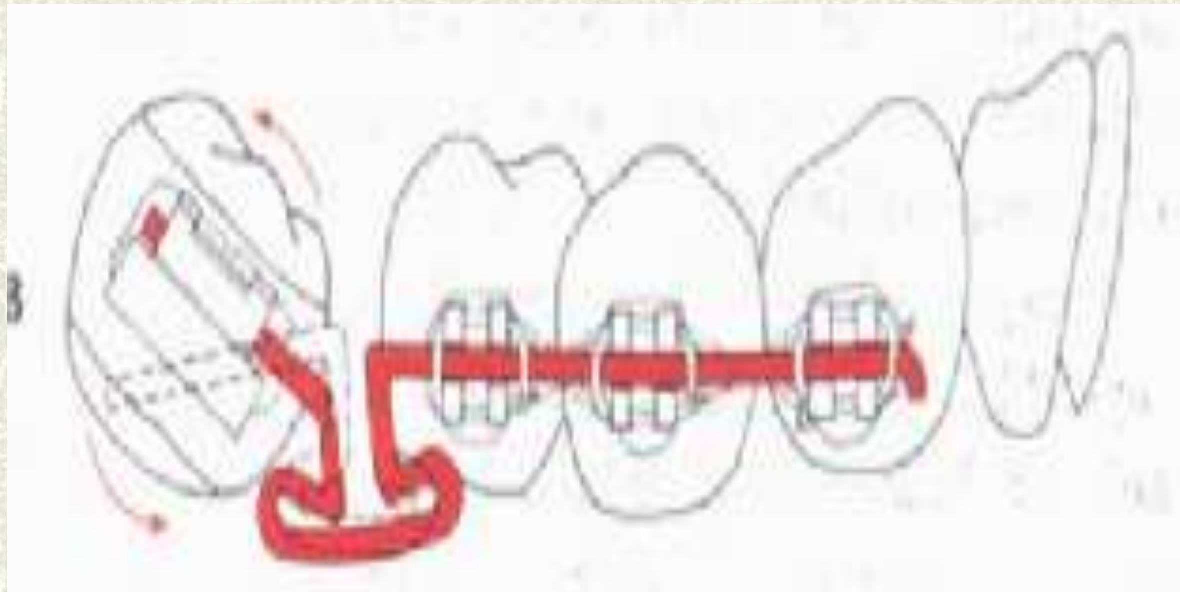
for molar uprighting

- If the treatment plan includes maintaining or closing rather than increasing the pontic space,
- the distal end of the archwire should be pulled distally through the molar tube, opening the T-loop by 1 to 2 mm.

Orthodontic Technique:

for molar uprighting

The end of the wire is then bent sharply gingivally to maintain this opening.



Orthodontic Technique:
for molar uprighting

- This activation provides a mesial force on the molar that counteracts distal crown tipping while the tooth uprights.

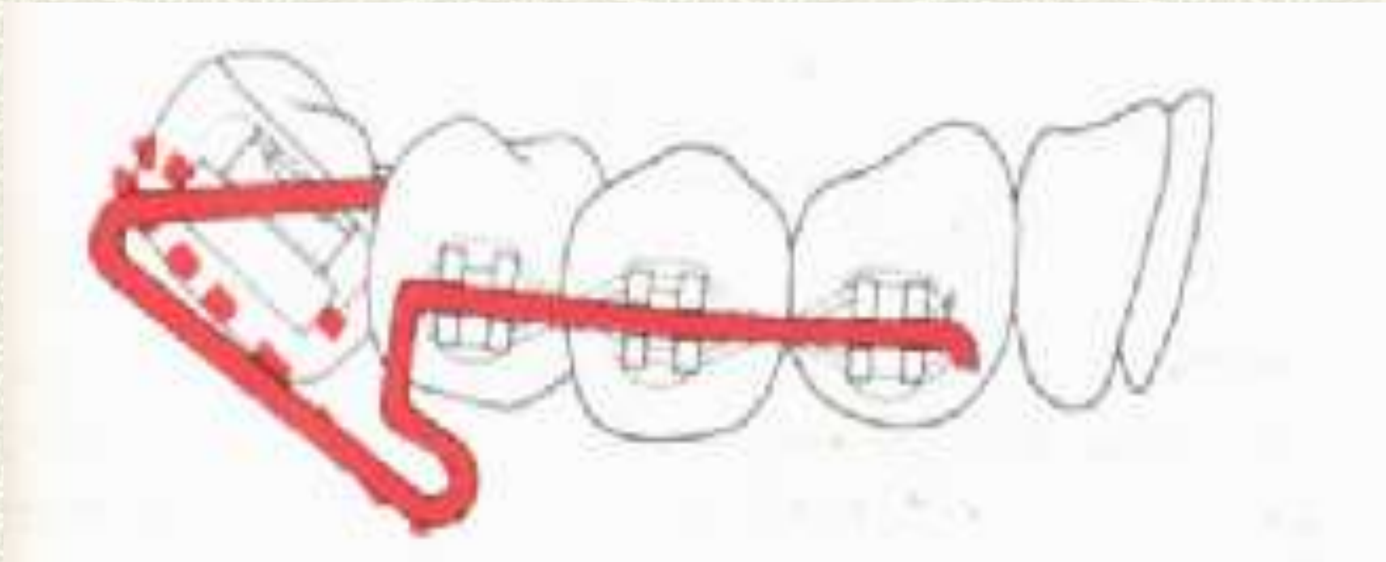
- Since the extrusive forces generated with this appliance are small, it is ideally suited for patients in whom the opposing tooth has been lost.

Orthodontic Technique:

for molar uprighting

Severely rotated teeth

the design of the T-loop is modified so that the end of the archwire is inserted from the posterior aspect of the molar tube.



Orthodontic Technique:

for molar uprighting

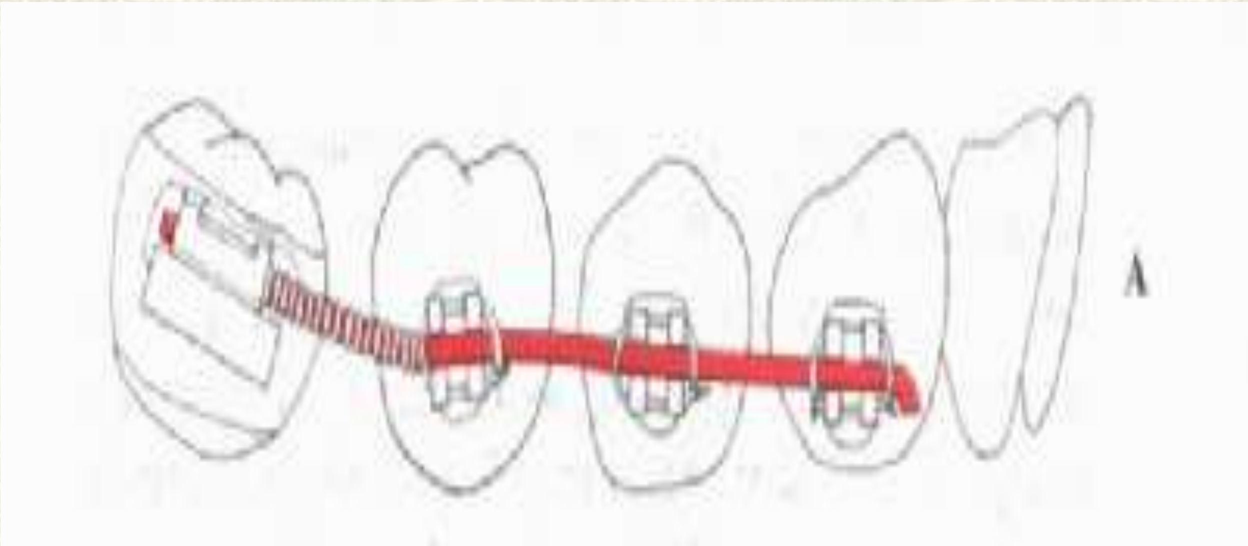
Final Positioning of Molar and Premolars

Once the molar uprighting has been almost accomplished, if it is desirable to increase the available pontic space and close any open contacts in the anterior segment

a relatively stiff base wire, with a compressed coil spring threaded over the wire is used to produce the required force system.

Orthodontic Technique:
for molar uprighting

The base wire should be 17 X 25 rectangular steel wire, which should engage the anchor teeth and the uprighted molar more or less passively.



Orthodontic Technique:
for molar uprighting

- The wire should extend through the molar tube, projecting about 1mm beyond the distal.
- An open coil spring over the base wire, when compressed between the molar and distal part of anchor segment should exert a force mesially while continuing to tip the molar distally.

Orthodontic Technique:
for molar uprighting

Retention.

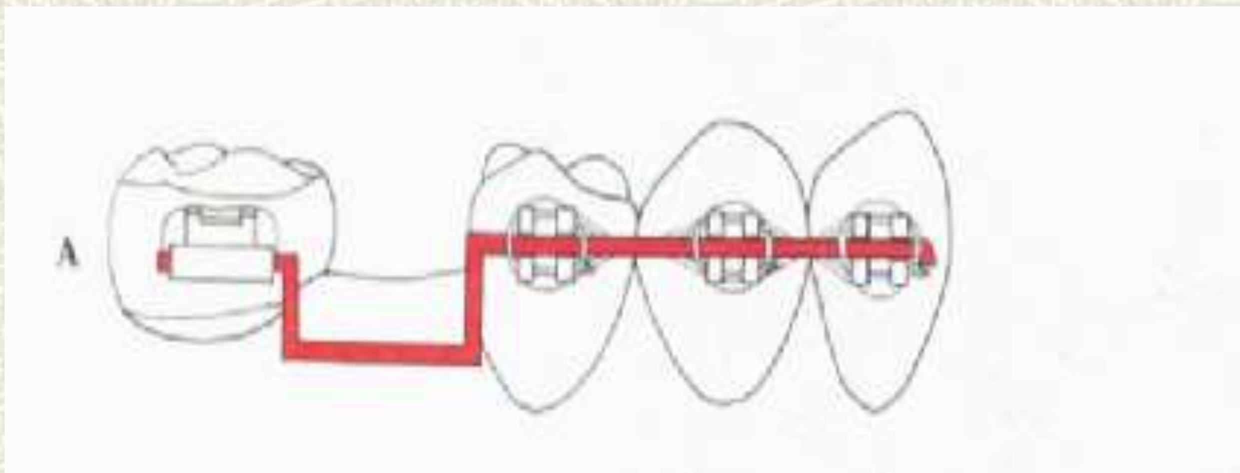
After molar uprighting, the teeth are in an unstable position until the fixed or removable prosthesis that provides the long-term retention is placed.

before placement of prosthesis intermediate form of splinting is necessary

Orthodontic Technique:
for molar uprighting

two methods of intermediate splinting.

1. A 19 x 25 steel or 21 x 25 beta-Ti wire designed to fit the brackets passively will prevent any tooth movement.



Orthodontic Technique:
for molar uprighting

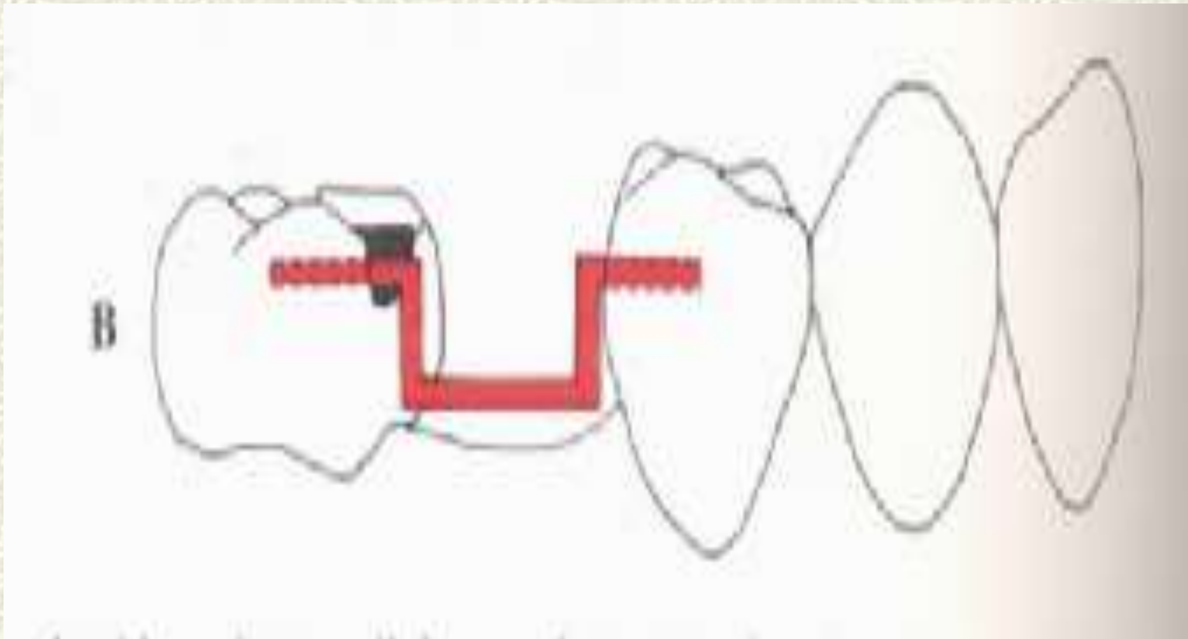
2. Intracoronal Splint

Shallow cavities prepared in the abutment teeth

splint of 19 x 25 or heavier steel wire secured intracoronally with either amalgam or composite resins.

Orthodontic Technique:
for molar uprighting

This type of splint causes little gingival irritation and can be left in place for a considerable period.



Forced Eruption

Indications.

- Teeth with defects in the cervical third of the root
- Isolated teeth with one or two walled - vertical periodontal defects
- To obtain good access for endodontic and restorative procedures
- To reduce pocket depth.

Forced Eruption

- Allows the placement of crown margins on sound tooth structure while maintaining a uniform gingival contour that produecs improved esthetics.
- In addition, the alveolar bone height is not compromised the apparent crown length is maintained, and

Forced Eruption

Treatment Planning.

Before beginning treatment, it is essential to have good periapical radiographs to examine

- the vertical extent of the detect
- the periodontal support
- the root morphology and position

Forced Eruption

- Ideal root morphology single tapering root.
- Flared or divergent roots will result in increasing root proximity with extrusion and possibility of exposing root furcation area.
- Hypercementosis or dilaceration of the root may make forced eruption complicated.
- The occlusion examined to check for sufficient space within arch and relative to the opposing teeth.

Forced Eruption

Factors determining the amount of extrusion

(I) the location of the defect (fracture line, root perforation. etc.) that is being treated

(II) space to place the margin of the restoration so that it is not at the base of the gingival sulcus (typically, 1mm is needed)

Forced Eruption

Length of time required for extrusion

- the age of the patient,
- the distance the tooth has to be moved
- the viability of the PDL.

Too much force, and too rapid a rate of movement, has the risk of tissue damage and ankylosis

Forced Eruption

Orthodontic Technique.

Appliance should be

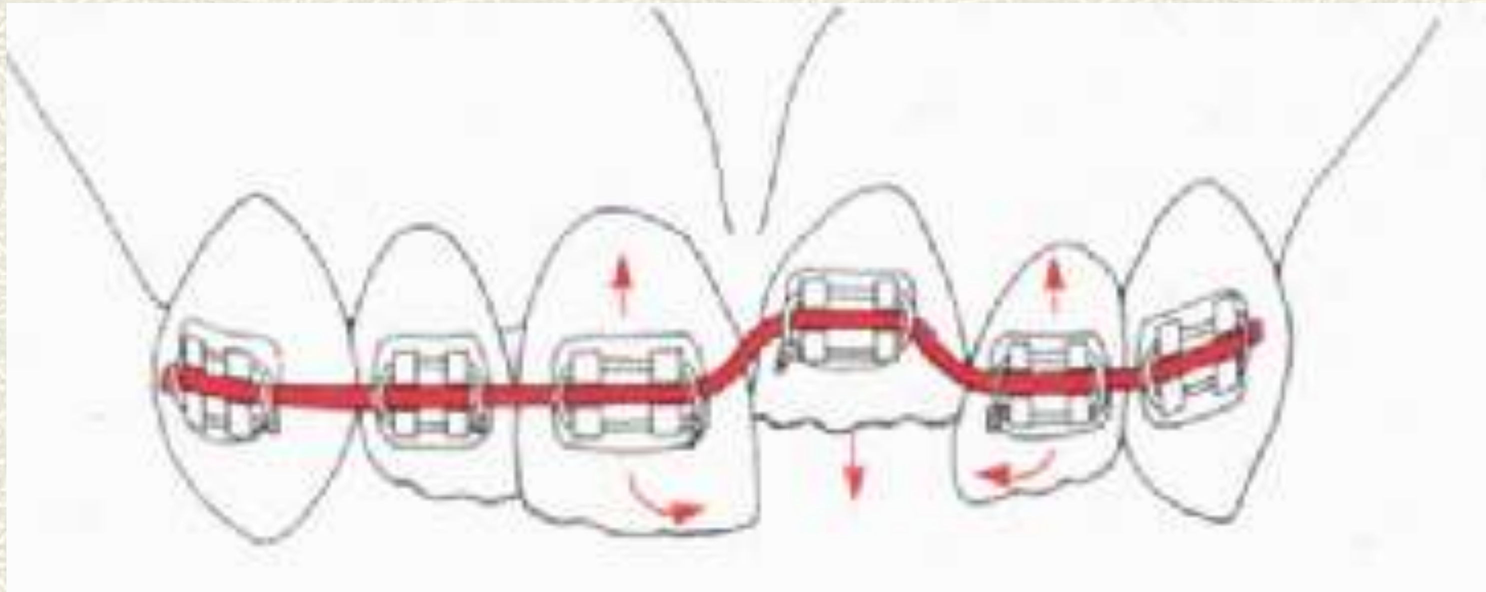
- rigid over the anchor teeth,
- flexible where it attaches to tooth being extruded.

This contraindicates use of a continuous flexible archwire,

Forced Eruption

Orthodontic Technique…

Produce the desired extrusion but also tip the adjacent teeth toward tooth being extruded, reducing the space for subsequent restorations.



Forced Eruption

Orthodontic Technique…

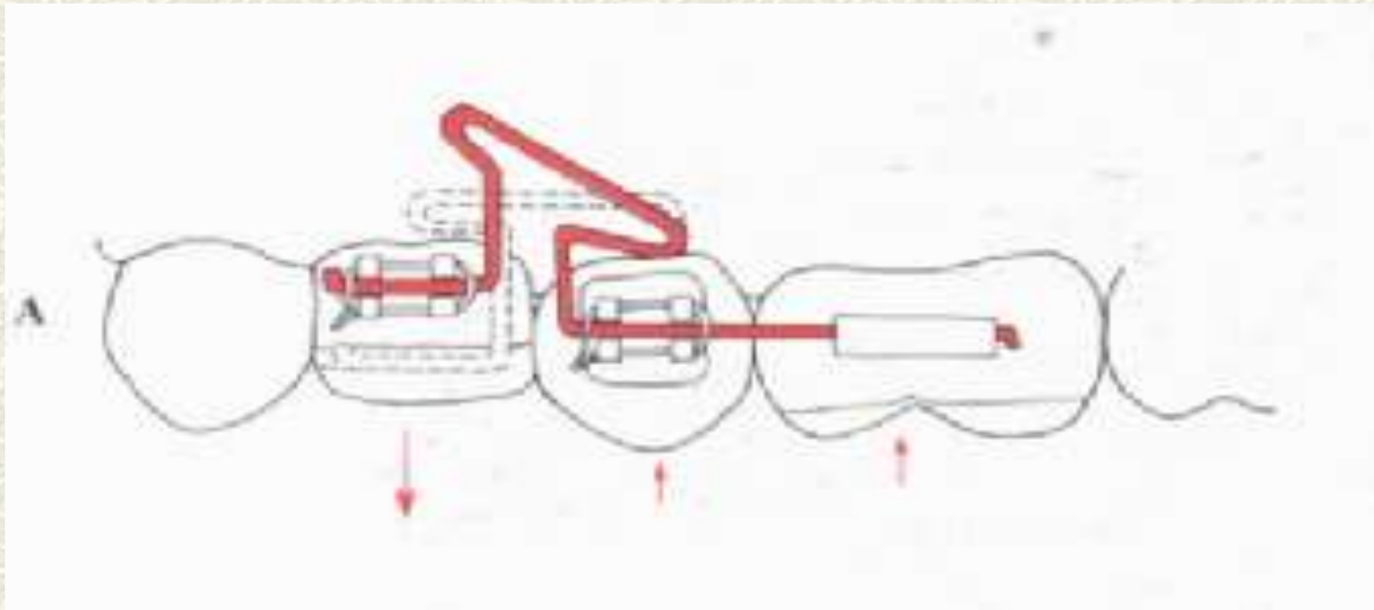
Two alternative appliances

- **A modification of the T-loop appliance** used to upright tipped molars

- Two or three adjacent teeth should be bonded to serve as the anchor unit.

Forced Eruption
Orthodontic Technique…

- A T-loop archwire is made from 17 x 25 stainless steel or 19 - 25 beta- Ti to cause extrusion.



Forced Eruption

Orthodontic Technique…

- **The second appliance**

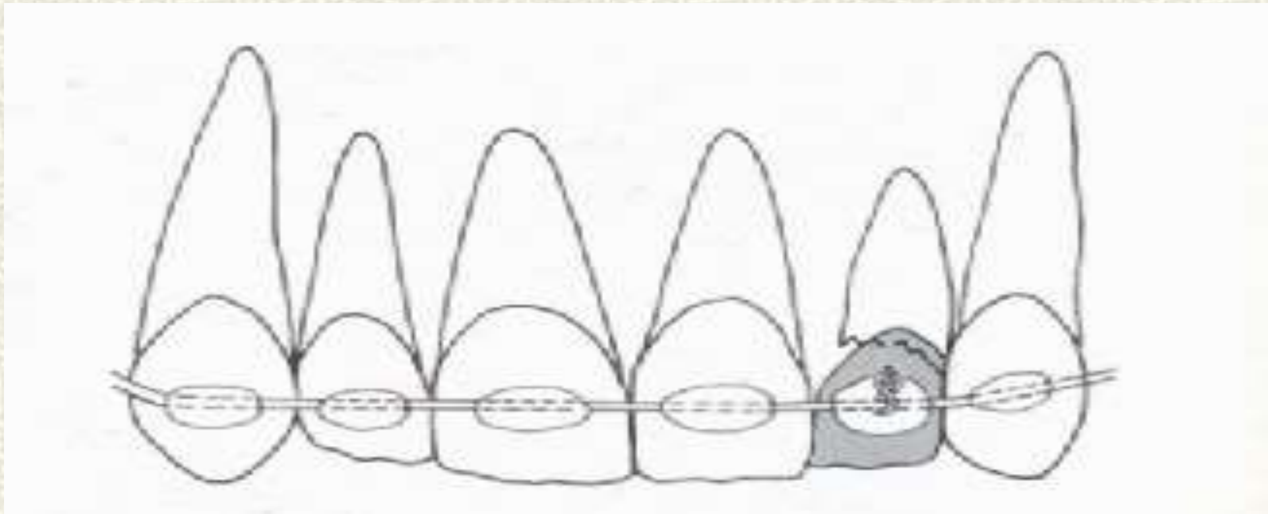
- heavy stabilizing wire, 19 X 25 stainless steel, bonded directly to the facial surface of the adjacent teeth.

- A post and core with temporary crown and pin placed on tooth to be extruded,

Forced Eruption

Orthodontic Technique…

- an elastorneric module or auxillary spring used to extrude the tooth.



Alignment of Teeth

Indications.

- To improve access for placement of well-adapted restorations
- To permit placement of crowns and pontics without overcontoured crowns that would produce poor embrasure form
- To establish good interproximal contacts

Alignment of Teeth

Indications…

- Provide better directed occlusal loadings,
- Minimize the possibility of occlusal interferences.

Alignment of Teeth

Treatment Planning.

A “diagnostic setup” is helpful, particularly in crowding or spacing to be corrected.

- the study casts are duplicated
- malaligned teeth are carefully cut from model,
- crown dimensions are modified if appropriate,

the teeth are then waxed back onto the cast in a new position.

Alignment of Teeth
Treatment Planning…

Length of time required to align teeth varies with

- the age of the patient,
- the distance the teeth have to be moved,
- the cellular activity within the PDL.

If it takes more than 6 months then it is better handled with comprehensive orthodontic treatment.

Implant vs.bridge

- Orthodontic Differences in

  Positioning of teeth

  Sequence of treatment

- Major concerns include

➢ Adequate bone in edentulous area to support the implant

➢ Adequate space between the roots and crowns of adjacent teeth

Orthodontic- Prosthodontic – Implant Interactions…

- When an implant is planned for missing maxillary lateral incisor or lower second premolar
- Primary tooth should be maintained as long as possible

If primary tooth is lost

Try to get maxillary canine or mandibular first molar to erupt in edentulous space

ADULT ORTHODONTIC PATIENT TYPES

Case type	Characteristic of major problem areas	Associated healthy systems	Treatment
Physiologic occlusion (exhibits no signs of existing pathosis)	• Mild dental malalignment • normal occlusion or malocclusion that is esthetically acceptable	•Occlusal stability •No decay and lack of occlusal wear •Psychological balance	Orthodontist Consultation and patient education (i.e., present condition requires no orthodontic treatment).

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Physiol-ogic occlusion (exhibits no signs of existing pathosis)		•TMJ asymptomatic •No speech impairment •No occlusal awareness •No functional disorders	•Relieve concern of referring dentist that condition probably won't get worse •Make patient aware of existing health levels

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Physiologic occlusion (exhibits no signs of existing pathosis)			• Document present condition

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Psychological disorientation	•**Concern about minor dental condition far exceeding real significance of the problem**	•Dentition aligned •Skeletal balance •TMJ asymptomatic •Periodontium healthy	•Make patient aware of the dental health condition •Psychological councelling as needed

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Adjunctive orthodontics	•Mild or moderate dental-skeletal malrelationship with periodontal and/or restorative needs	•Periodontal resistance •All other systems within normal limits	Periodontist, restorative dentist,or hygienist Caries and inflammatory control

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Adjunctive orthodontics			**Restorative dentist** **Patient acceptance of restorative or prosthetic commitment** **Orthodontist** **Limited orthodontic treatment objectives**

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Adjunctive orthodontics			Stabilization and retention (usually sectional appliances) Restorative dentist/ periodontist Restorative therapy and periodontal therapy as needed.

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Corrective orthodontics	•Mild to moderate dental-skeletal disharmony •Unsatisfactory dentofacial esthetics	•Psychologic balance •Skeletal WNL •TMJ asymptomatic •No tooth replacement required	Restorative dentist or hygienist Caries and inflammatory control

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Corrective orthodontics			Orthodontist Comprehensive orthodontic therapy (extraction/non extraction) Dentist or hygienist

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Corrective orthodontics			Scaling and curettage at 3 to 6mm intervals Orthodontist •Retention •Periodic monitoring of oral health needs.

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Orthognathic surgery	•Dental-skeletal and/or neuromuscular disharmonies of moderate to severe degree		Restorative dentist Caries and inflammatory control Orthodontist Presurgical intra-arch orthodontic preparation

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Orthognathic surgery			Reevaluate records Oral surgeon Orthognathic surgery to correct skeletal-dental disharmony Orthodontist post surgical orthodontic therapy

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Orthognathic surgery			Retention records Oral surgeon or plastic surgeon Adjunctive surgical procedures (genioplasty, rhinoplasty, facelift)

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Periodontally susceptible	•Dental-skeletal malrelationship with moderate to advanced bone loss •Primary secondary occlusal trauma may be present	•Emotional balance •TMJ asymptomatic •Other systems may be affected secondarily	Restorative dentist or hygienist Caries and inflammatory control

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated healthy systems	Treatment
Periodontally susceptible			Periodontist or hygienist •Maintenance of root surface preparation •Subgingival removal of microbiota •Gingival grafting procedures

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
Periodontally susceptible			Orthodontist Comprehensive therapy Selective grinding Retention Periodontist reevaluation and definitive periodontal procedures

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
TMJ dysfunction	•Dental-skeletal malrelationship with joint dysfunction •TMJ symptoms	Other systems may be affected	Orthodontist Diagnostic appliance to achieve relief of symptoms and to determine degree of skeletal disharmony and need for further diagnosis

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
TMJ dysfunction			**Psychotherapist** **Counseling as needed/stress reduction program** **Orthodontist** **•Occlusal therapy** **•Comprehensive orthodontics**

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
TMJ dysfunction			•Selective grinding Oral surgeon Surgical management Restorative dentist Restorative dentistry if required

Case type	Major problem areas	Associated systems	Treatment
Enamel wear beyond that expected for chronologic age	•Heavy musculature (mandibular deficiency) •Dental-skeletal deep-bite	Other systems may be affected secondary	Restorative dentist •Caries or inflammatory control •Occlusal control

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
Enamel wear beyond that expected for chronologic age			Orthodontist Comprehensive orthodontics •Periodontal surgery •Crown lengthening •Restorative dentistry if required

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
Dental mutilations	•Premature loss of teeth or congenitally missing teeth •May involve bite collapse and loss of vertical height	Associated systems WNL but may be affected as secondary	Restorative dentist •Caries and inflammatory control •Occlusal control with modified treatment goals

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
Dental mutilation			Comprehensive orthodontic treatment with modified goals Periodontist Adjunctive periodontal treatment restorative dentistry Tooth replacement

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
Borderline surgical case	•Dentofacial imbalance of moderate severity •Basal bone discrepancy in both jaws contribute to dentofacial imbalance	•Adequate attached gingiva for dental compensation in each arch •Patient accepts dentofacial imbalance	Restorative dentist •Caries and inflammatory control •occlusal guard to control wear

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
Borderline surgical case	Imbalance looks greater than it is		•Orthodontist •Differential diagnosis of skeletal component to the problem •Deprogram muscles and reevaluate with mounted study models

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
Borderline surgical case			•Comprehensive orthodontic treatment Oral surgeon •Evaluate records and provide surgical opinion •Advise patient of risks and benefits of surgery

ADULT ORTHODONTIC PATIENT TYPES

Case type	Major problem areas	Associated systems	Treatment
Dental mutilations			Interdisciplinary dental therapy (IDT).

Conclusion

Thus it can be concluded that adult orthodontic treatment though having the same basic goals and biomechanics has certain important differences from the conventional adolescent treatment that should be carefully evaluated .

References

Luther F : orthodontics and TM joint: where are we now? Part 2 functional occlusion, malocclusion and TMD, Angle Orthod 68:357-368,1998.

Hom BM, Turly PK: the effects of space closure of the mandibular first molar area in adults, AJO 85:457-469,1984.

Roberts WE et al : Rigid implant anchorage to close a mandibular first molar extraction site, JCO 28, 693-704,1994.

Folio J: Orthodontic therapy in juvenile periodontitis: clinical and microbiological effects.AJO, 87:421-431, 1985.

Kusy RP et al : analysis of moment to force ratios in the mechanics of tooth movement, AJO90: 127-131, 1986.

Proffit WR.:Contemporary Orthodontics: third edition

Graber TM, Vanarsdall, Orthodontics : Current principals and techniques, third edition.

Bishara SE Text book of orthodontics