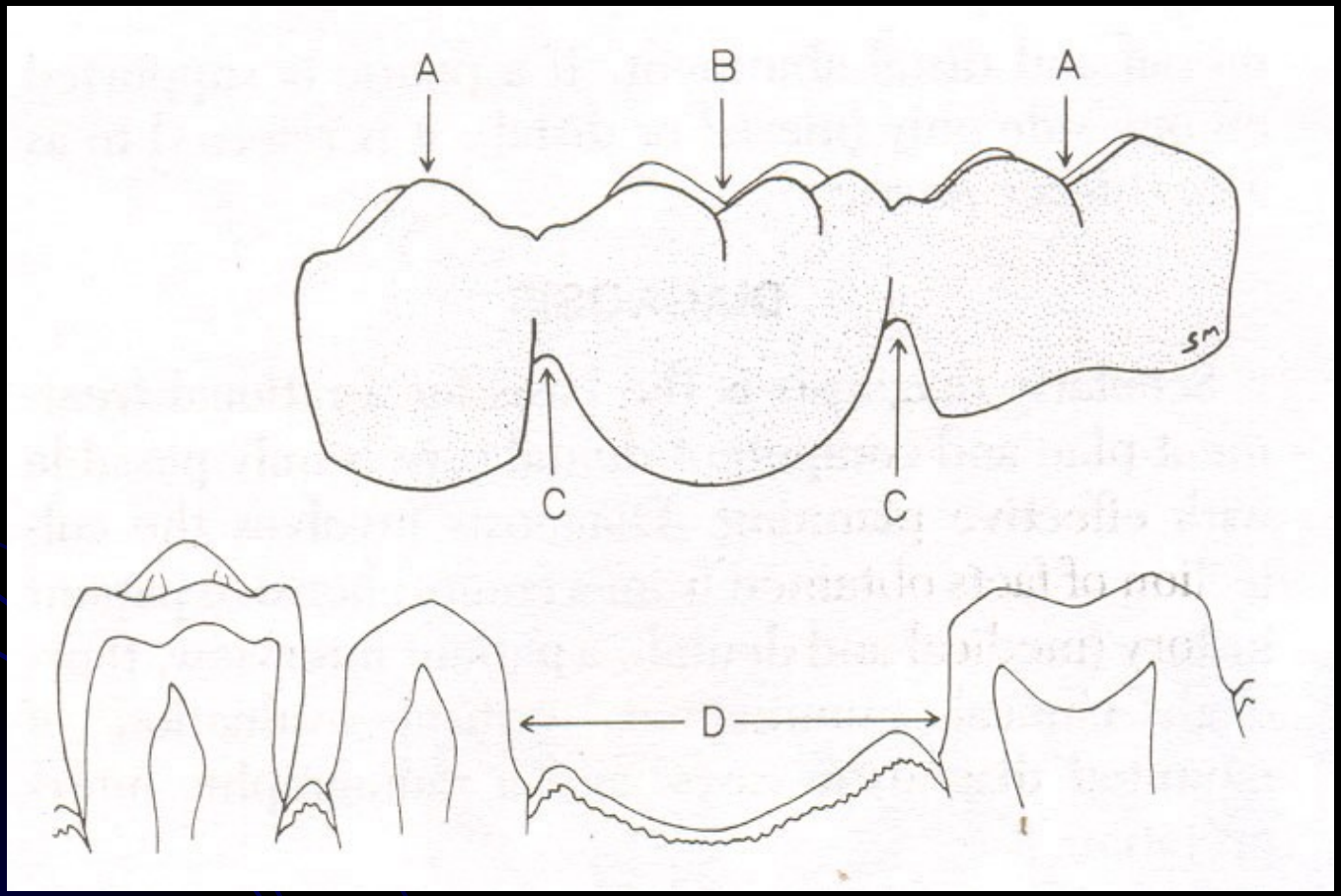
SELECTION OF ABUTMENT

DESIGN OF A FIXED PARTIAL DENTURE



DESIGN OF A FIXED PARTIAL DENTURE

- One of the best known rules for bridge design was devised by ANTE in 1926
- He suggested that each pontic should be supported by the same root surface area covered by bone as would have supported the missing tooth
- This rule was based on the engineering principles used for designing bridges

ANTE'S LAW

"The abutment teeth should have a combined pericemental area equal to or greater in pericemental area of the tooth to be replaced "

However, a clinician must not depend upon the calculated ratio as individual crown to root ratio, root morphology & occlusal conditions are equally important

ABUTMENT

- The teeth that support the fixed partial denture are the abutments
- The glossary of prosthodontic terms defines it as a tooth , a portion of a tooth, or that portion of a dental implant that serves to support &/or retain a prosthesis
- It is that part of a structure that receives thrust or pressure

NEED FOR SELECTION OF ABUTMENT

- Every restoration must be able to withstand constant occlusal forces to which it is subjected
- This is of particular significance when designing & fabricating a fixed partial denture, since the forces that would normally be absorbed by the missing tooth are transmitted , through the pontic, connector, & retainers , to the abutment teeth
- Abutment teeth are therefore called upon to withstand the forces normally directed to the missing teeth, in addition to those usually applied to the abutments

SELECTION OF ABUTMENT

This can be discussed under different heads as –

- Abutment evaluation
- Biomechanical considerations
- Special cases
  - Pier abutments
  - Tilted molar abutment
  - Canine replacement fixed partial denture
  - Cantilever fixed partial denture
  - Available tooth structure & crown morphology

ABUTMENT EVALUATION

- The supporting tissues surrounding the abutment teeth must be healthy & free from inflammation before any prosthesis can be contemplated
- Normally, abutment teeth should not exhibit mobility, since they will be carrying an extra load
- The roots & their supporting tissues should be evaluated for three factors :

1.Crown – root ratio

2. Root configuration

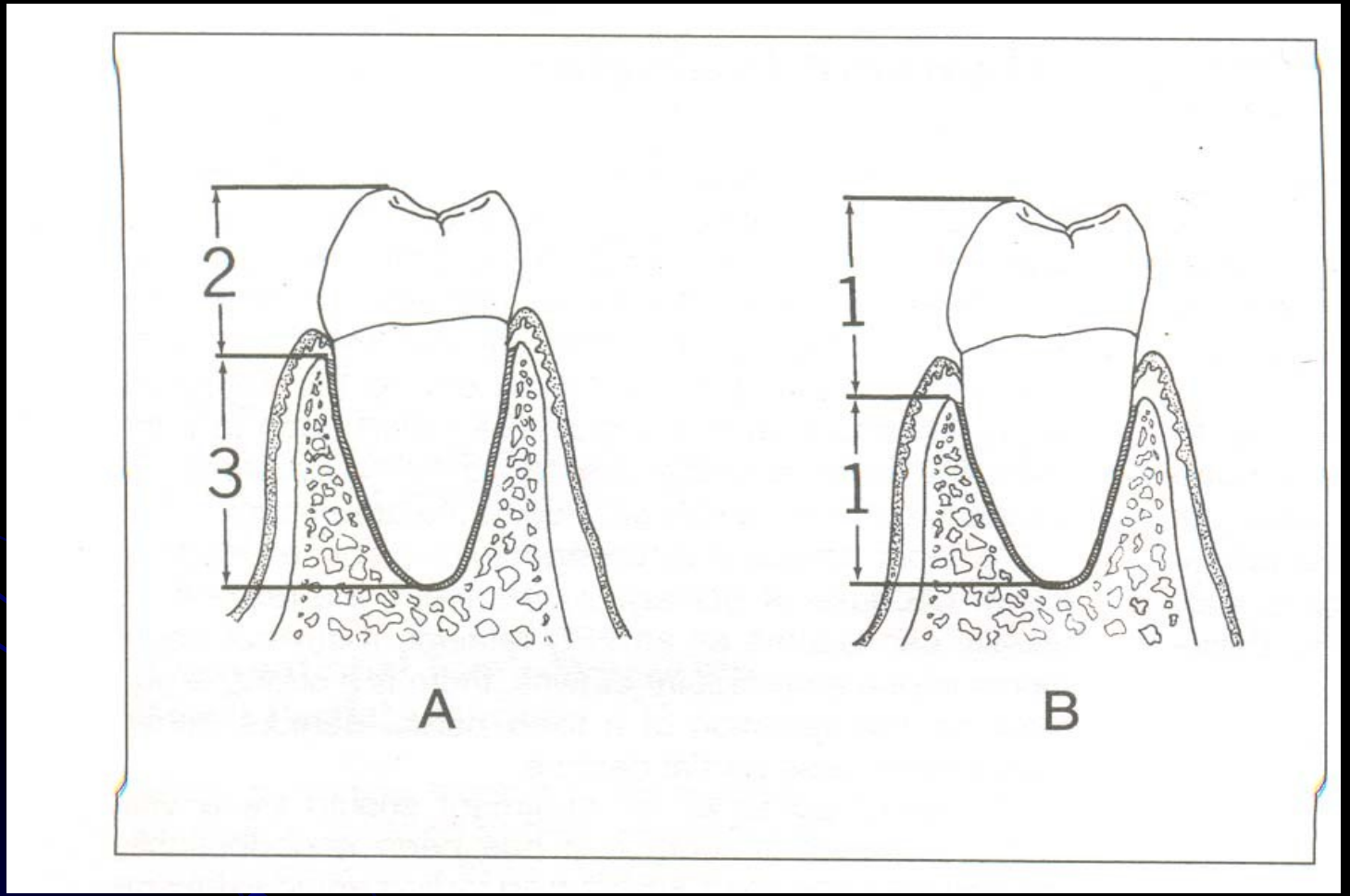
3.Periodontal ligament area

CROWN – ROOT RATIO

- This ratio is a measure of tooth occlusal to the alveolar crest of the bone compared to the length of root

  embedded in the bone
- As the alveolar bone moves apically, the lever arm of that portion out of bone increases ,& the chance for harmful lateral forces is increased
- The optimum crown – root ratio for fixed partial denture should be 2:3
- A ratio of 1:1 is the minimum ratio that is acceptable for a prospective abutment under normal circumstances

CROWN – ROOT RATIO



CROWN – ROOT RATIO

- The crown – root ratio alone is not an adequate criteria for evaluating a prospective abutment tooth

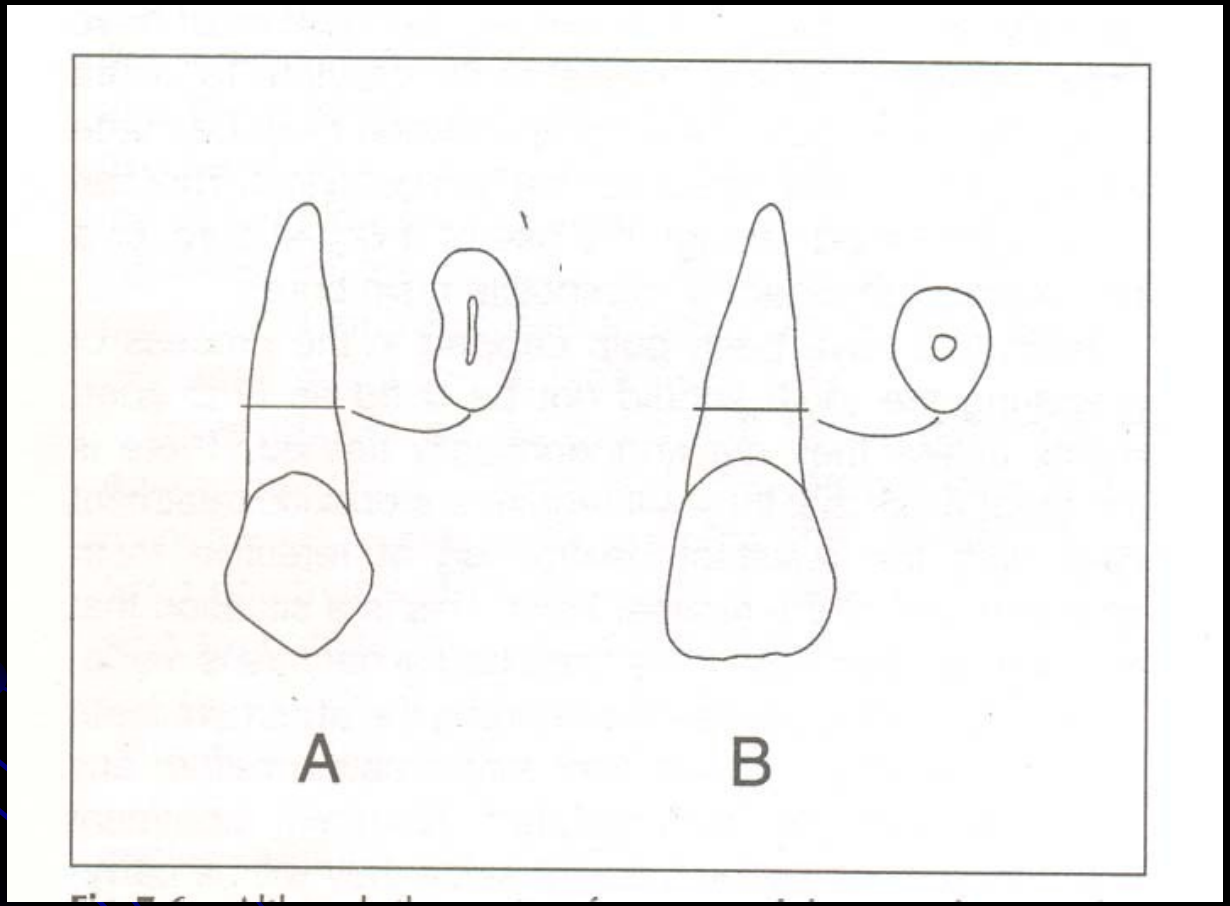
  - occlusion opposing a proposed fixed partial denture is composed of artificial teeth, occlusal force will be diminished , with less stress on the abutment

  - An abutment tooth with a less desirable crown – root ratio is more likely to be successful if the opposing occlusion is composed of mobile, periodontally involved teeth

ROOT CONFIGURATION

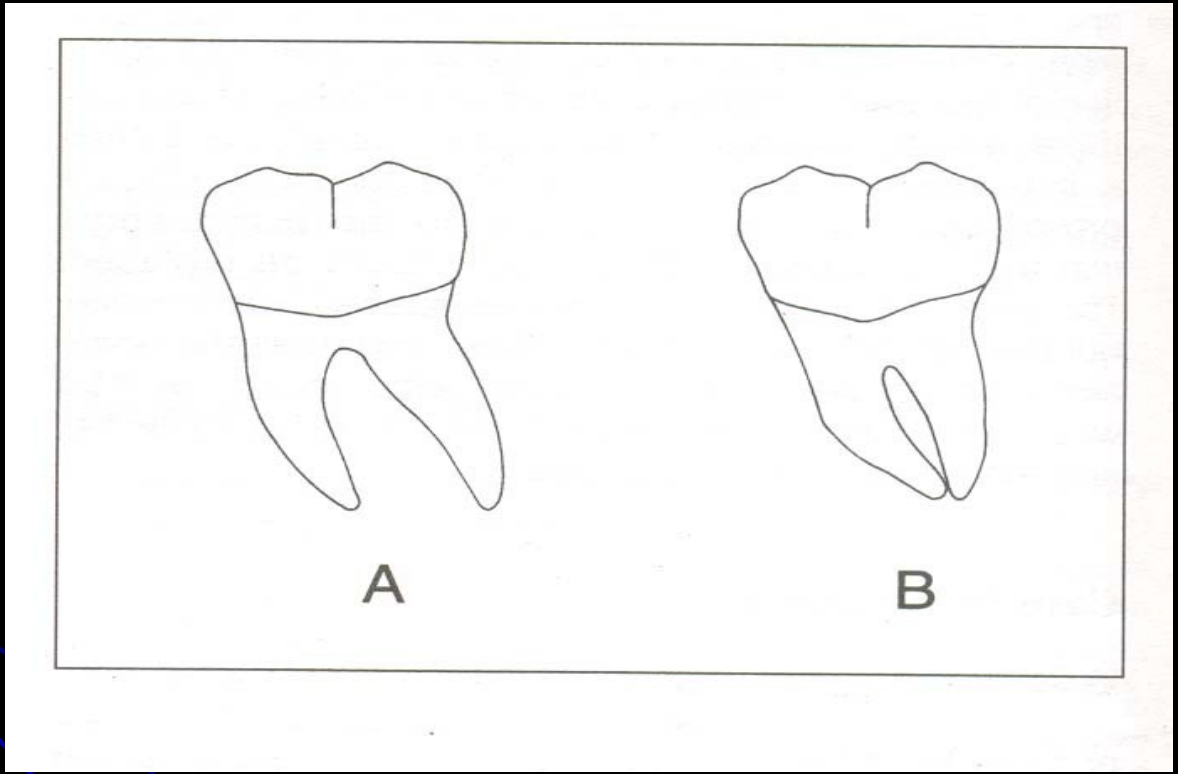
- Roots that are broader labioingually than they are mesiodistally are preferable to roots that are round in cross section
- Multirooted posterior teeth with widely separated roots will offer better periodontal support than roots that converge ,fuse. or generally present a conical configuration
- The tooth with conical roots can be used as an abutment for a short span fixed partial denture if all the other factors are optimal
- A single rooted tooth with irregular configuration or with some curvature in the apical third of the root serve as better abutment than with perfect taper

ROOT CONFIGURATION



A is a superior abutment due to greater faciolingual dimension than B

ROOT CONFIGURATION

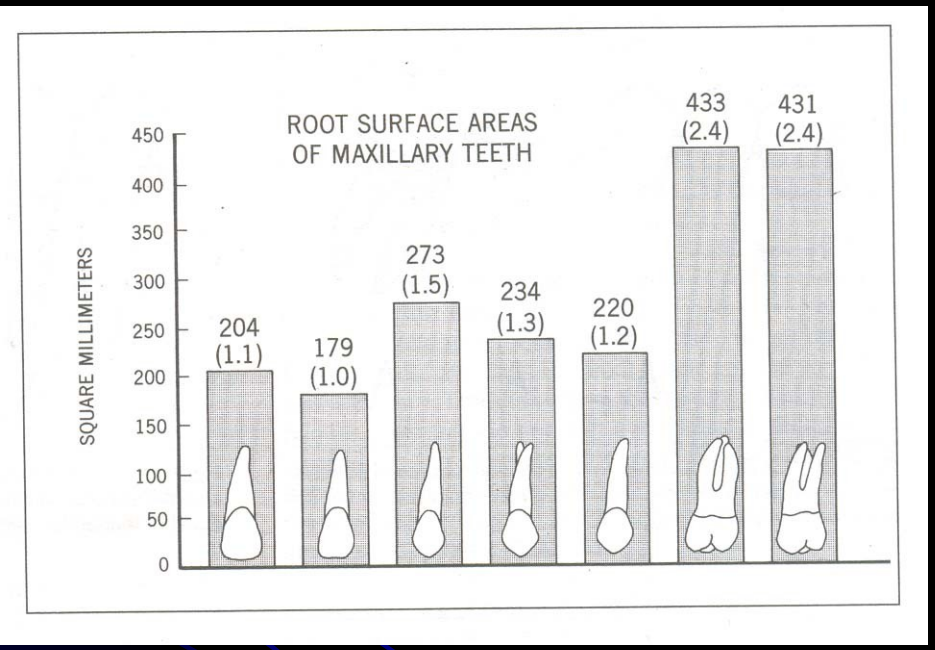


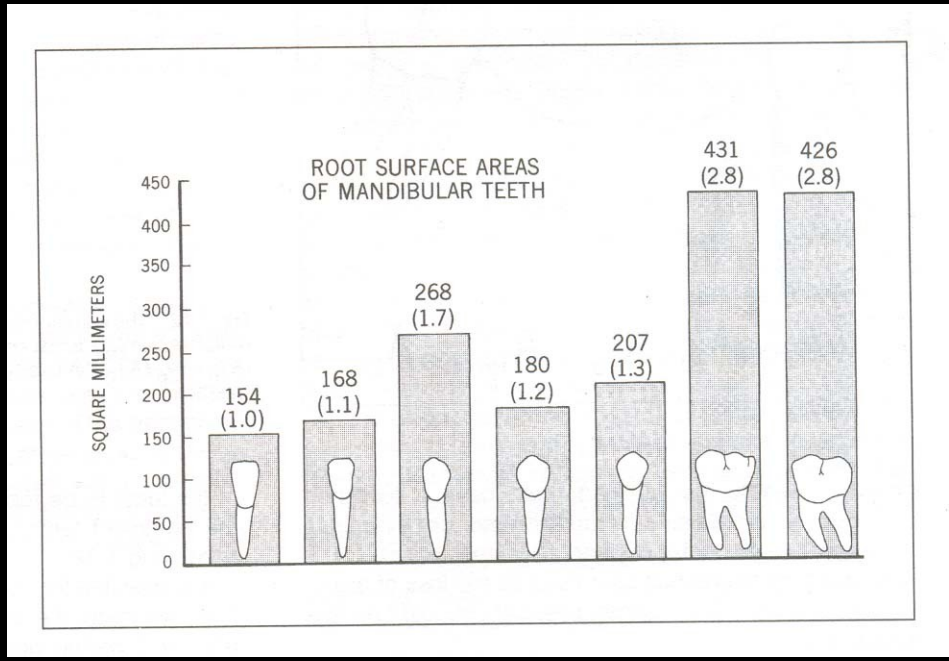
The molars with divergent roots are better than one whose roots are fused

PERIODONTAL LIGAMENT AREA

- Larger teeth have greater surface area & are better able to bear added stresses
- The areas of the root surface of various teeth have been reported by Jepsen

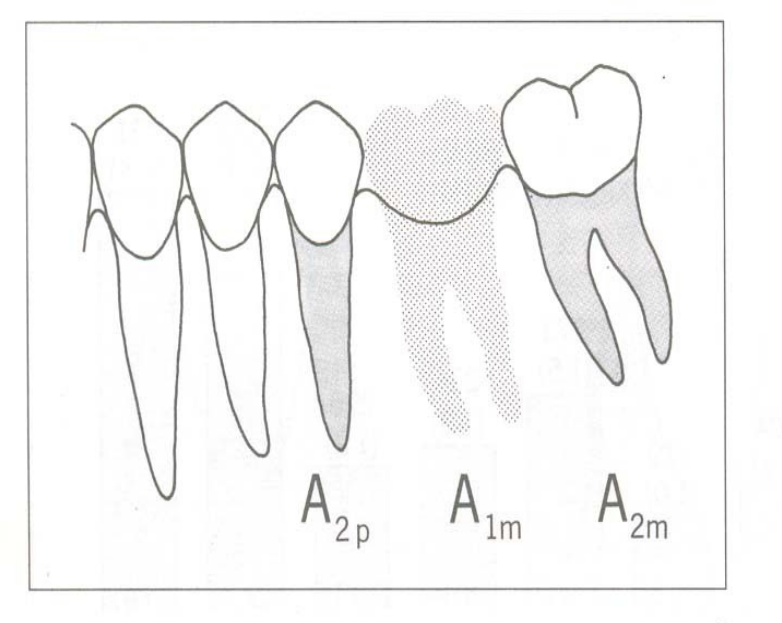
PERIODONTAL LIGAMENT AREA





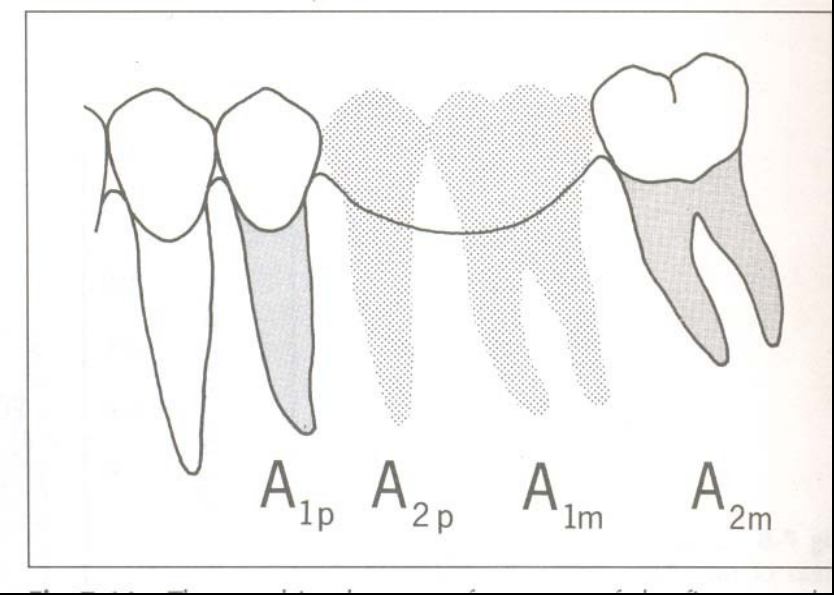
Root surface area of maxillary & mandibular teeth

PERIODONTAL LIGAMENT AREA



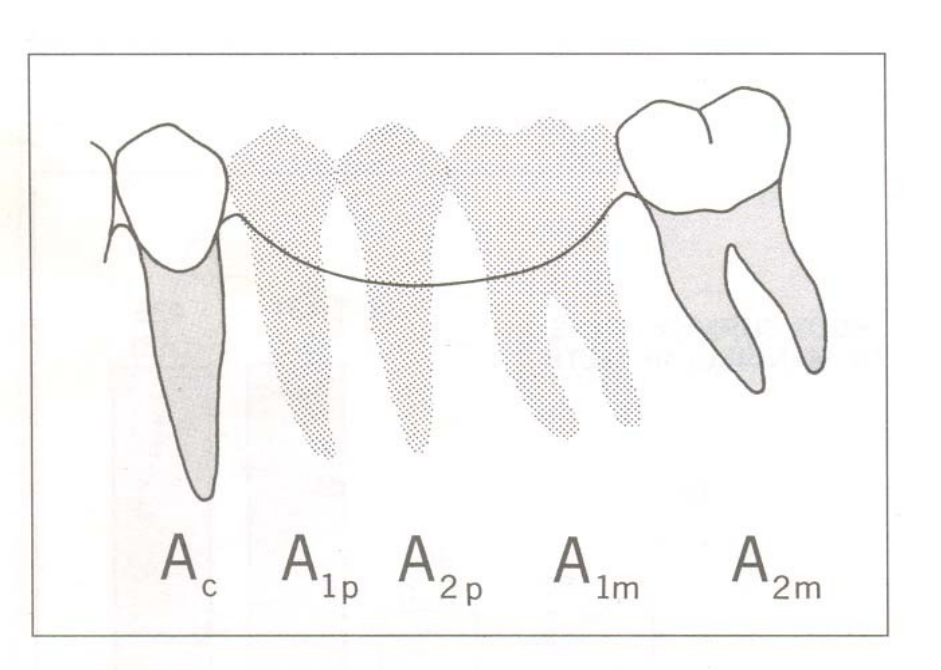
The combined root surface area of the second premolar & the second molar is greater than that of the first molar being replaced

PERIODONTAL LIGAMENT AREA



The combined root surface area of the first premolar & the second molar is approximately equal to that of the first molar being replaced

PERIODONTAL LIGAMENT AREA



The combined root surface area of the canine & the second molar is exceeded by that of the teeth to be replaced. A fixed partial denture would be a poor risk in this situation

PERIODONTAL LIGAMENT AREA

- After loss of supporting bone due to periodontal disease, the involved teeth have a lessened capacity to serve as an abutment
- The length of the pontic span that can be successfully restored is limited , in part, by the abutment teeth & their ability to accept the additional load
- TYLMAN stated that two abutment teeth could support two pontics
- Johnston followed the ANTE'S LAW

PERIODONTAL LIGAMENT AREA

- It is possible to replace more than two teeth for instance in anterior fixed partial denture replacing the four incisors
- However , any prosthesis replacing more than two teeth should be considered as high risk
- Short span pontics have a better prognosis than do with excessively long spans
- Long span pontics merely overstress the periodontal ligament

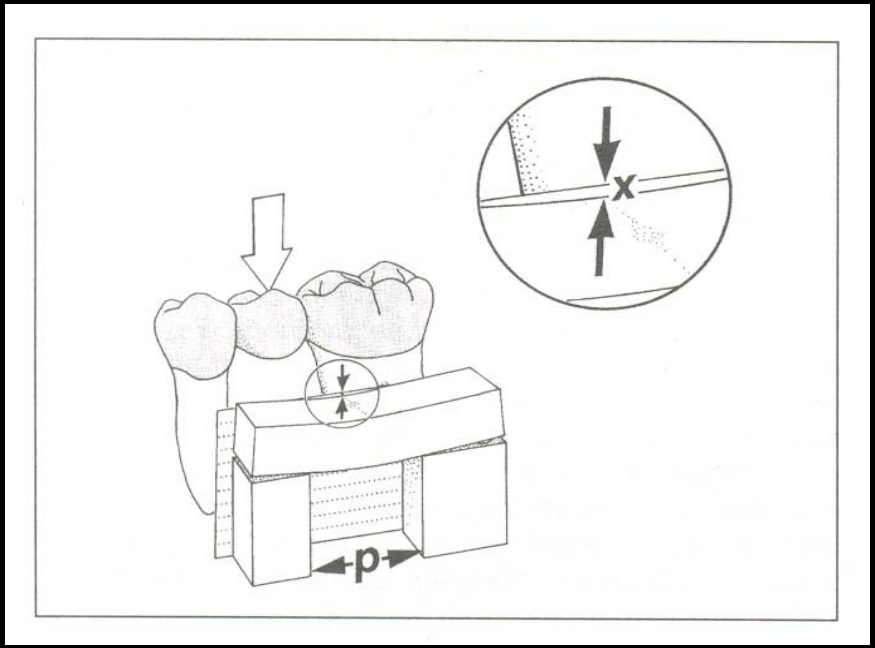
PERIODONTAL LIGAMENT AREA

- There is evidence that teeth with poor periodontal support can successfully serve as fixed partial denture in carefully selected cases
- Elimination of mobility is not the goal in such cases, but rather stabilization of teeth in a status to prevent increase in mobility
- Abutment in these situations can be maintained free on inflammation in the face of mobility, if the patients are well motivated & highly proficient in plaque removal
- It also emphasizes the extreme importance of carefully evaluating the strengths & weakness of the remaining dentition on an individual basis

BIOMECHANICAL CONSIDERATIONS

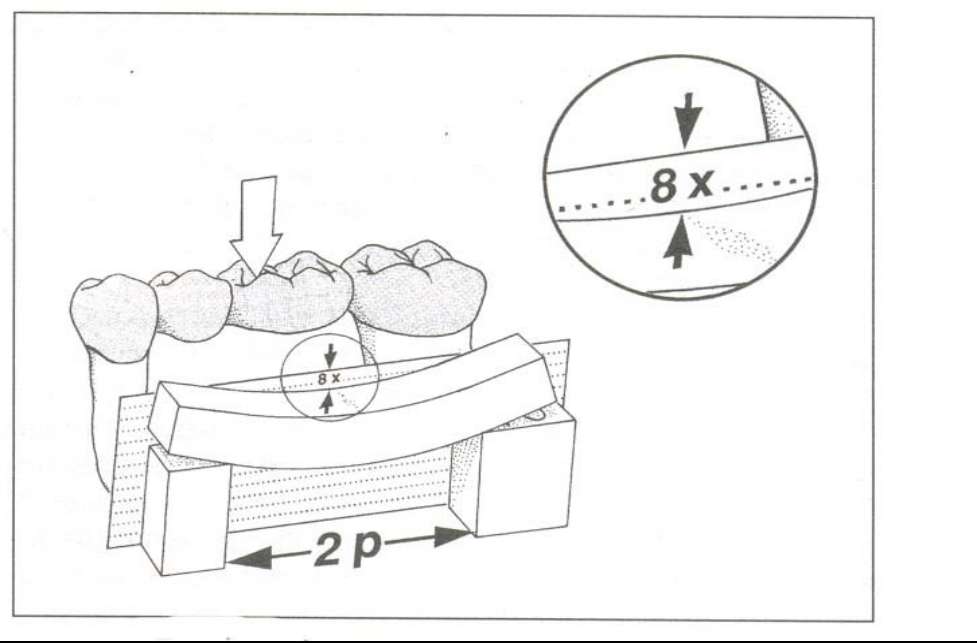
- Compared with a fixed partial denture having a single tooth pontic span, a two span pontic will bend 8 times whereas a three span pontic will bend 27 times as much as a single pontic
- Longer span pontics also have the potential for producing more torquing forces on the fixed partial denture, especially the weaker abutment
- Double abutments may be used to overcome problems created by unfavorable crown-root ratio & long spans
- Secondary abutment selection is crucial in such cases as it should be ready to bear additional forces

BIOMECHANICAL CONSIDERATIONS



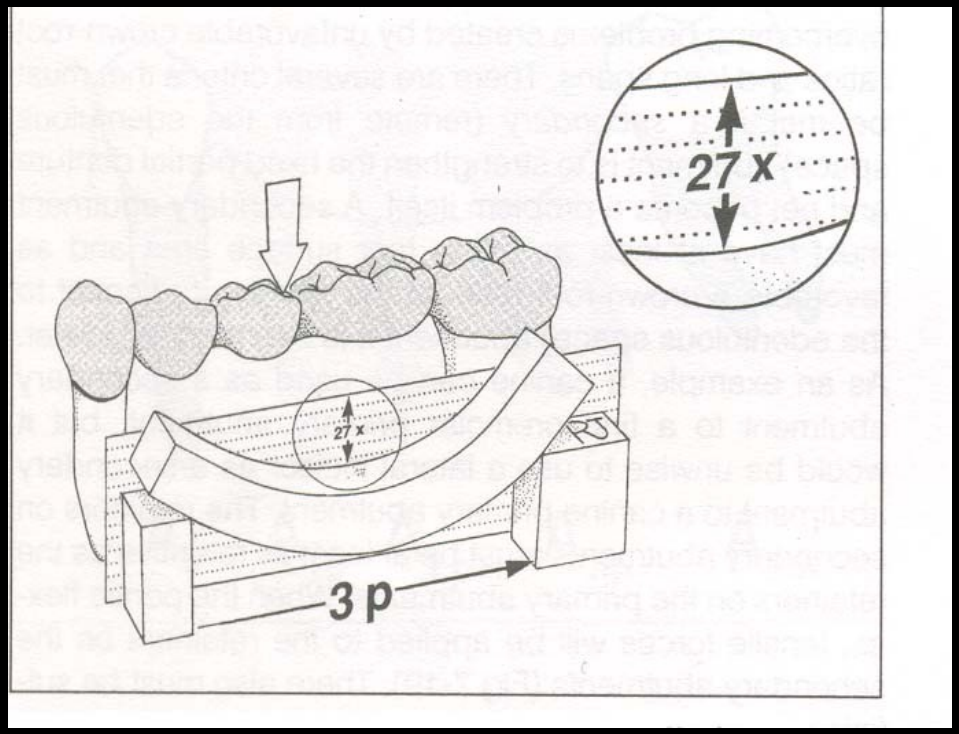
There is one unit of deflection (x) for a given span (p)

BIOMECHANICAL CONSIDERATIONS



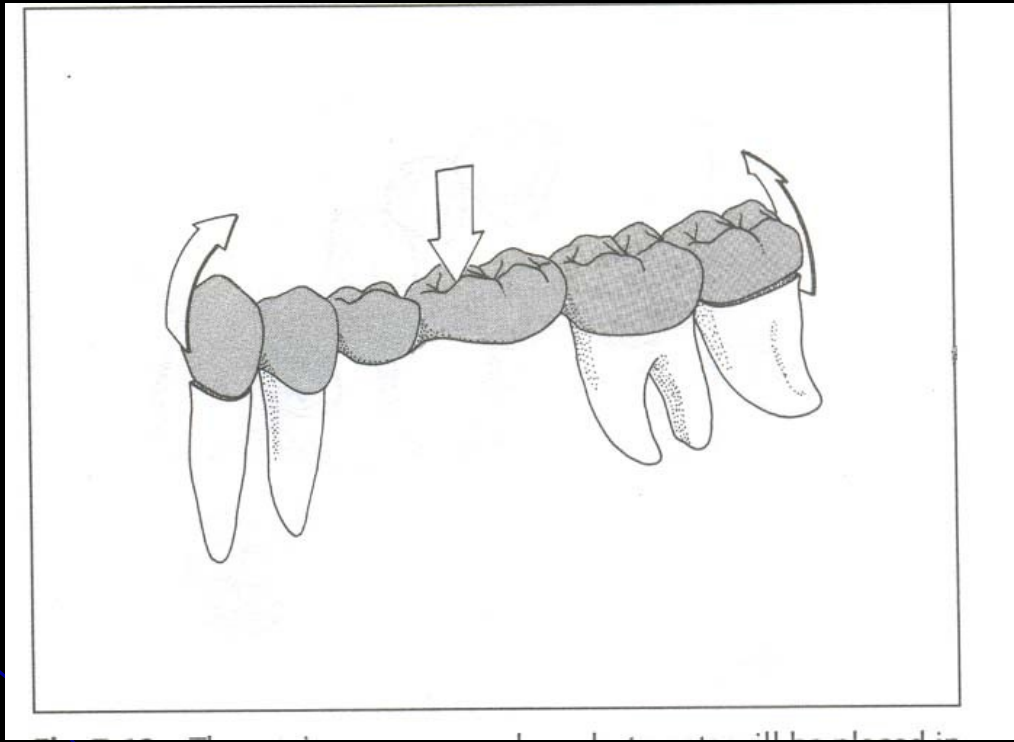
The deflection will be 8 times if the span is doubled

BIOMECHANICAL CONSIDERATIONS



The deflection is 27 times when the span length is tripled

BIOMECHANICAL CONSIDERATIONS

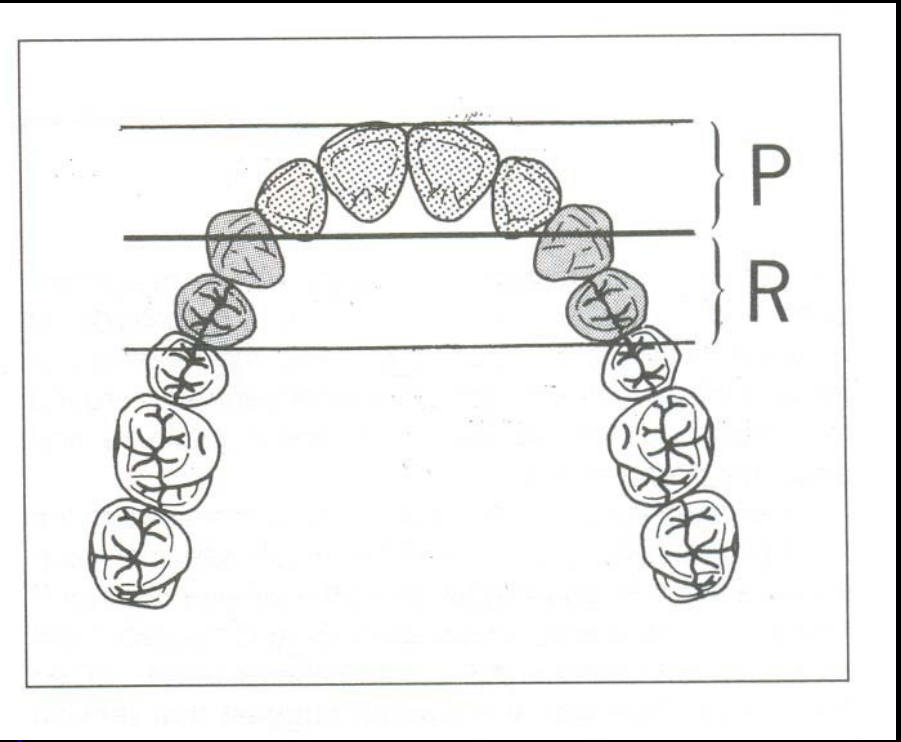


Secondary abutment used
along with the primary abutment

BIOMECHANICAL CONSIDERATIONS

- Arch curvature also plays an important role on the stresses occurring in a fixed partial denture
- For instance, when pontics lie outside the interabutment axis line , the pontics act as a lever arm producing a torquing movement in replacing all four maxillary incisors
- Select first premolar as secondary abutment to offset the torque

BIOMECHANICAL CONSIDERATIONS



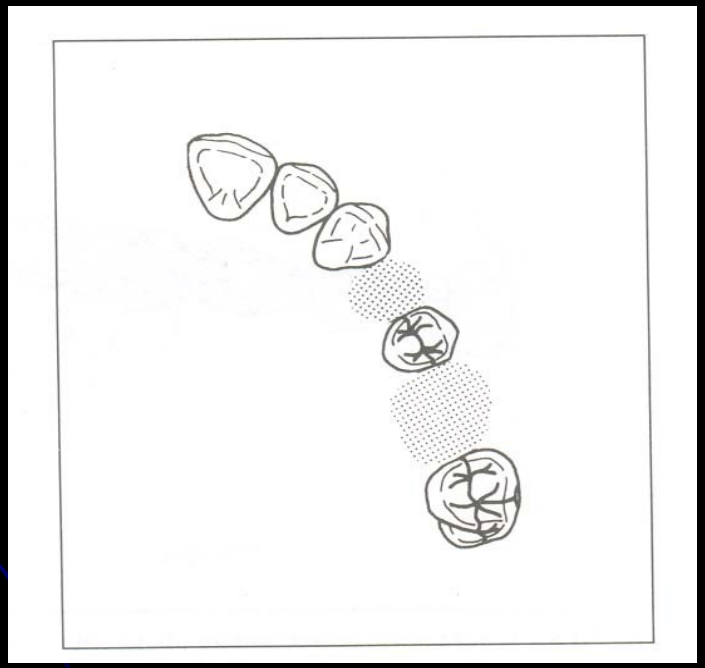
Secondary retention (R) must extend to a distance from the primary interabutment axis equal to the distance that the pontic lever arm (P) extends in the opposite direction

Special cases

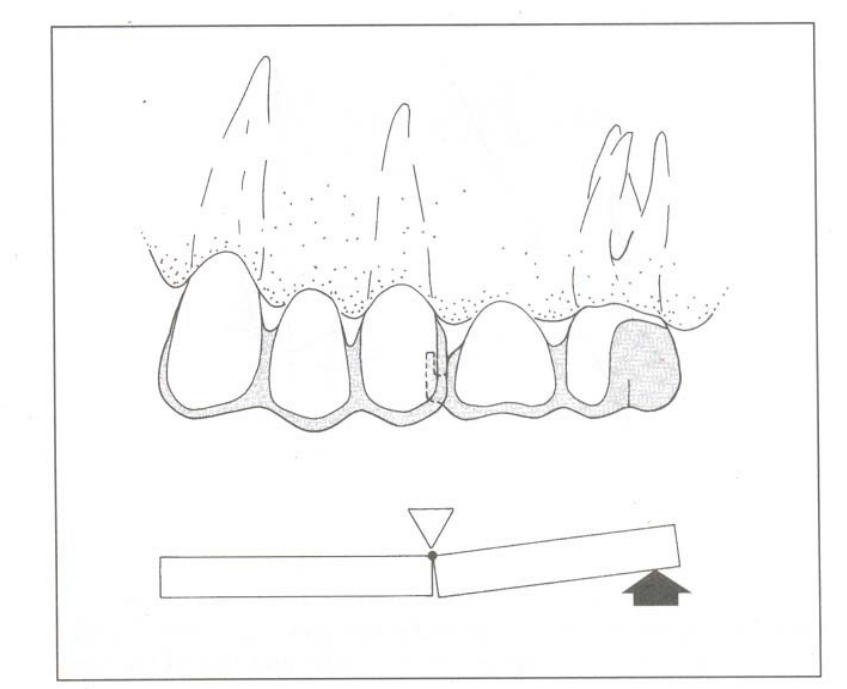
- A pier abutment or an intermediate abutment has the potential to produce unfavorable leverage & an unseating effect on terminal retainers
- Non-rigid connector has been suggested as a solution to this problem
- The female portion of the non rigid connector is commonly placed on the distal surface of the intermediate abutment

pier abutment or an intermediate abutment

A PIER abutment is a natural tooth located between terminal abutments that serve to support a fixed partial denture

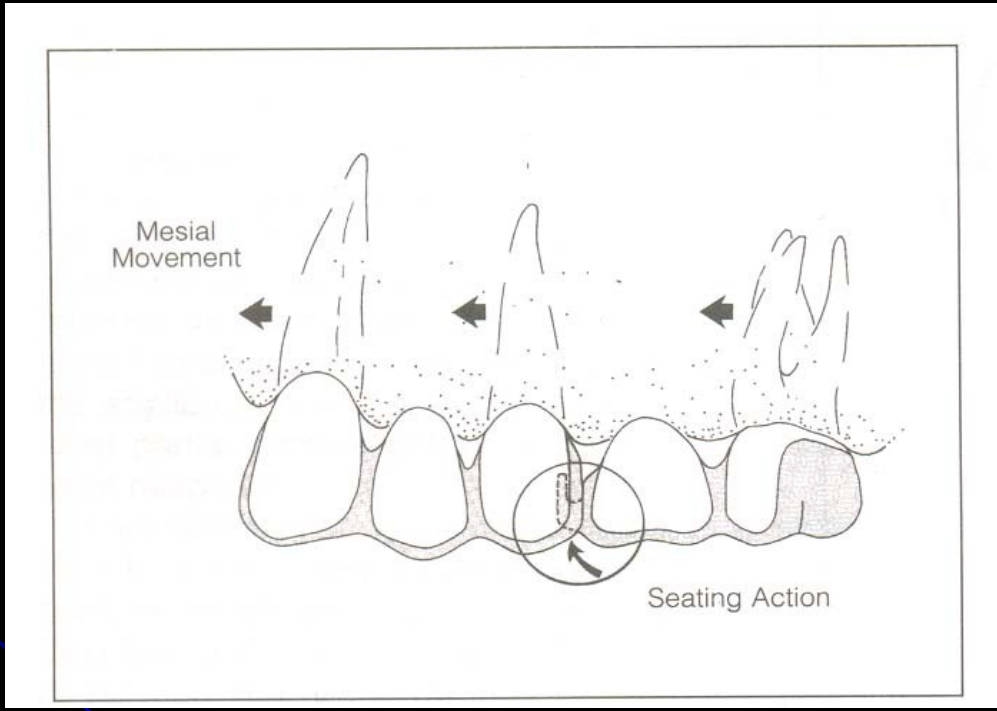


an intermediate abutment



A non rigid connector on the middle abutment isolates force to that segment of the fixed partial denture to which force is applied

an intermediate abutment

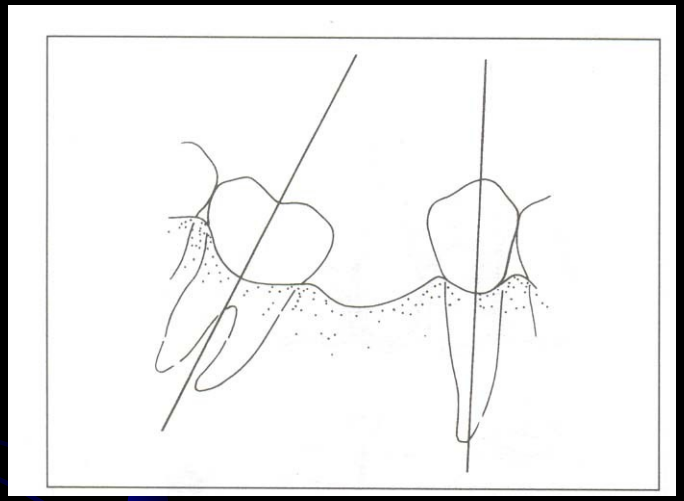


If non rigid connector is placed on the distal side the retainer on a middle abutment , movement in mesial direction will seat the key into the keyway

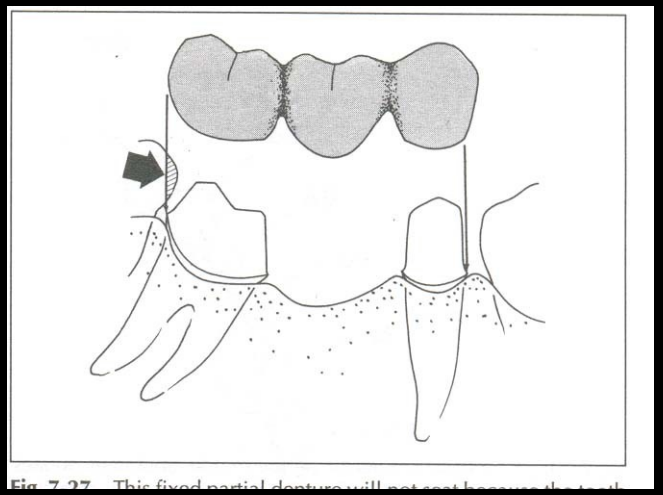
Tilted molar abutment

- The mesiolingually tilted molar is a commonly encountered problem
- It is impossible to prepare the abutment for a fixed partial denture along the axes of the respective teeth & achieve a common path of insertion
- Measure should be taken before we select this tooth as an abutment in fixed partial denture

Tilted molar abutment

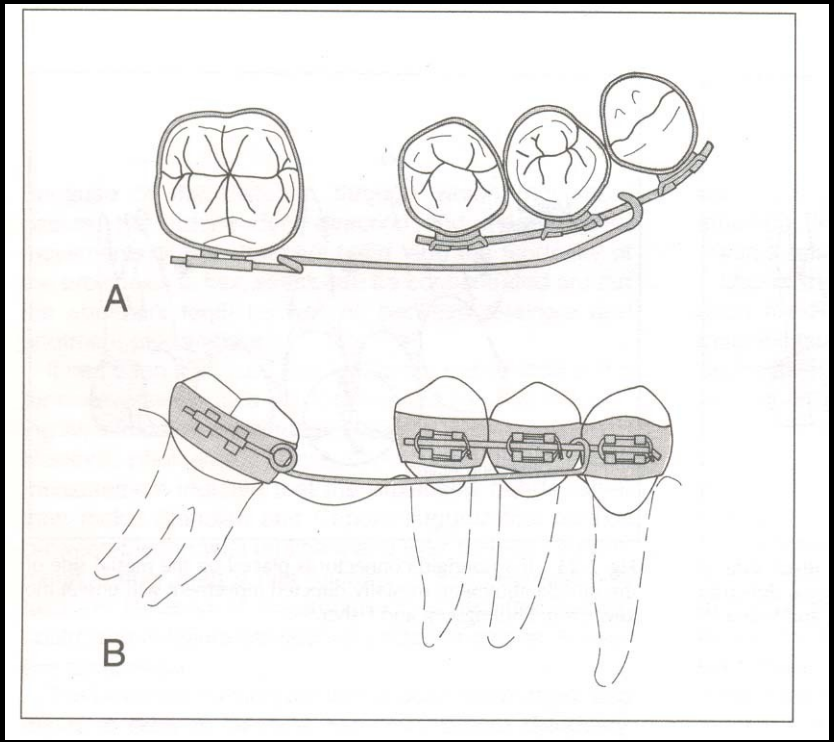


When a mandibular molar tilts mesially , there is a discrepancy between the long axis of the molar & that of the premolar



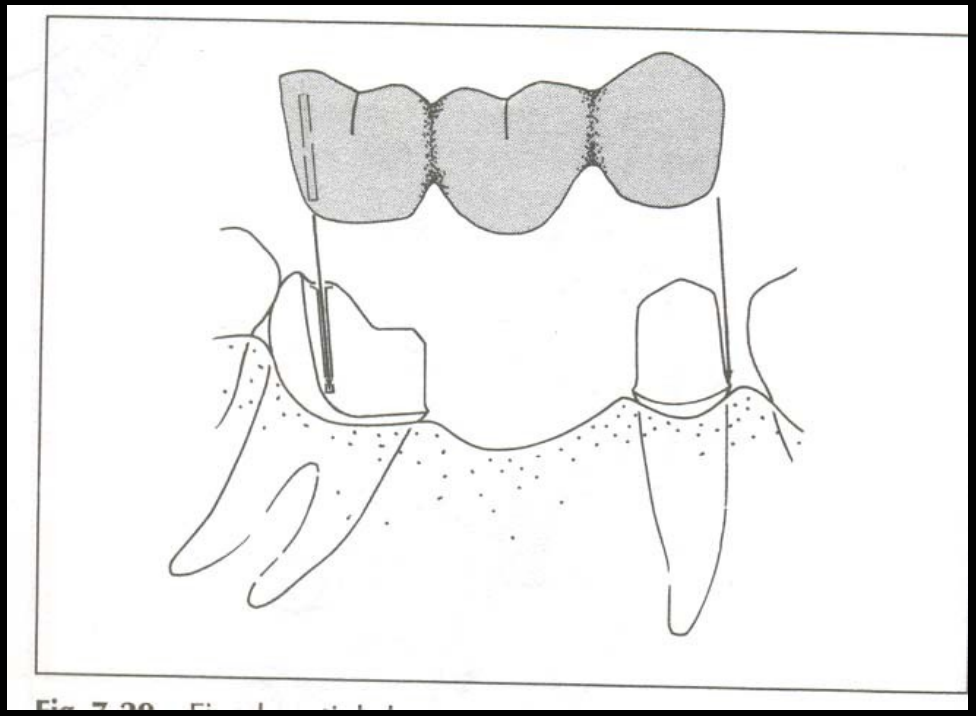
The fixed partial denture will not seat as the distal tooth intrudes on the path of insertion

Tilted molar abutment



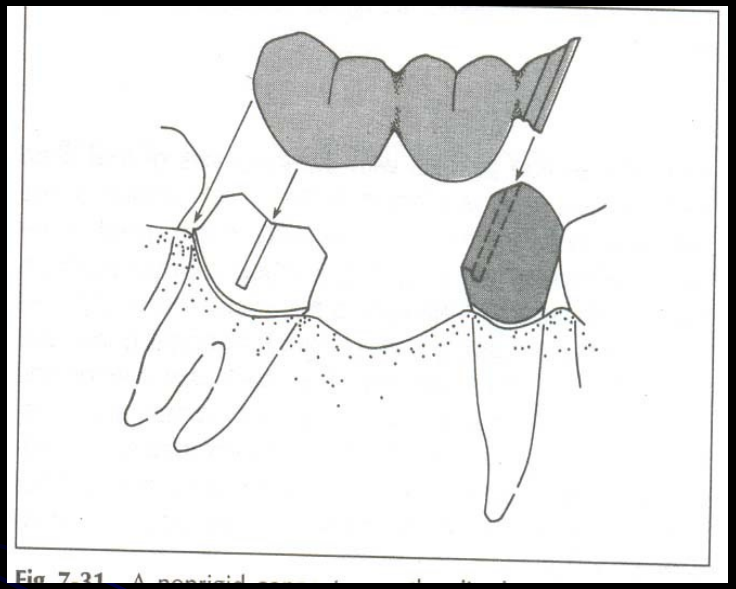
Orthodontic appliance for uprighting a tilted molar

Tilted molar abutment

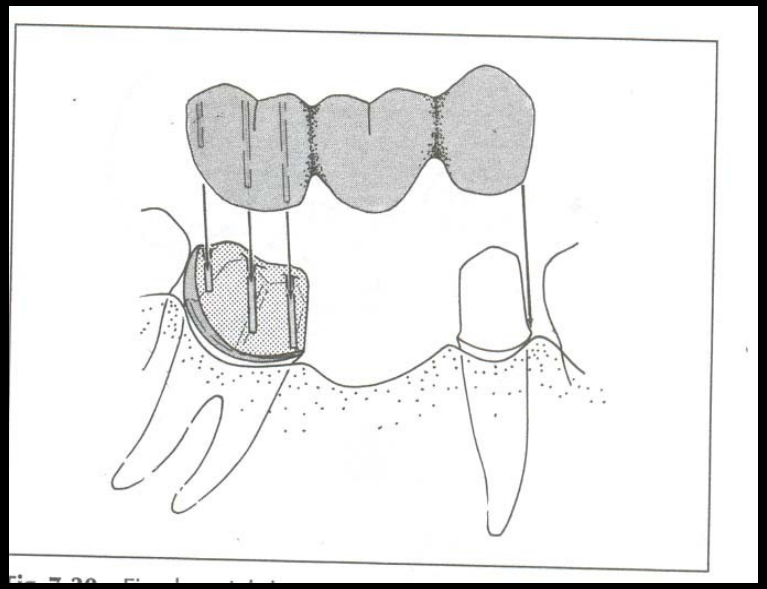


Fixed partial denture using a proximal half crown as a retainer

Tilted molar abutment



A non rigid connector on the distal aspect of the premolar retainer compensates for the inclination of the tilted molar



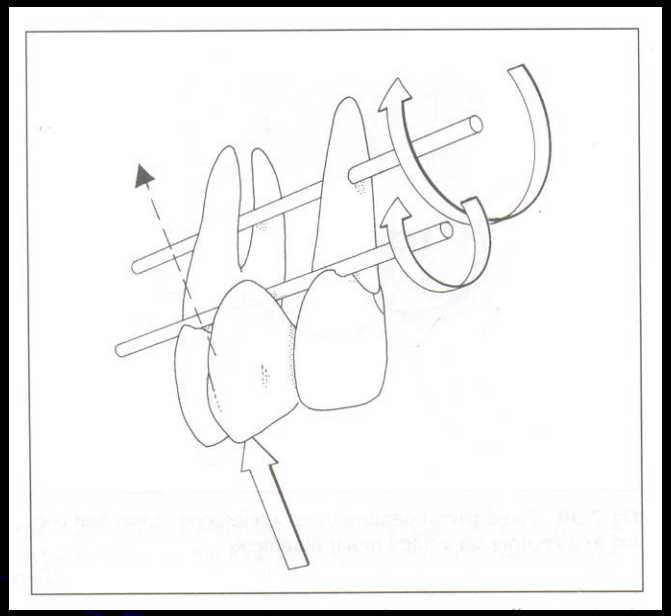
Fixed partial denture using a telescopic crown & a coping as a retainer on a tilted molar

Canine replacement fixed partial denture

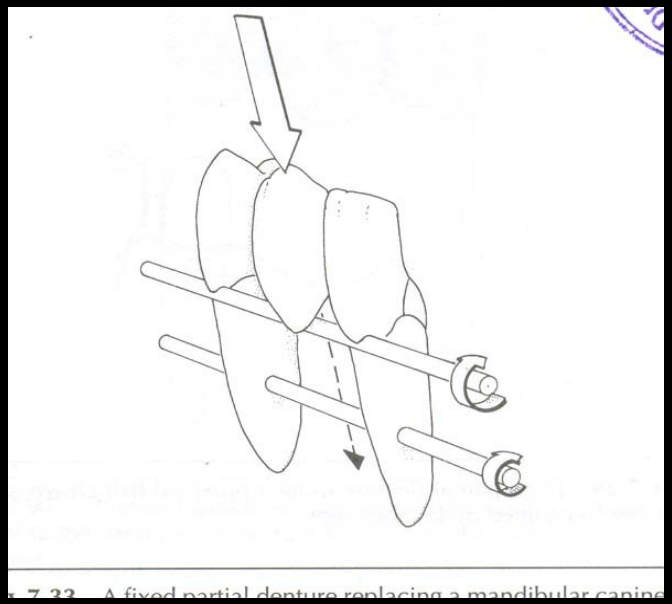
- Canine replacement by fixed partial denture can be difficult as the canines often lies outside the interabutment axis

- The prospective abutment lateral incisor usually weakest in the entire arch & first premolar, weakest posterior tooth

Canine replacement fixed partial denture



A fixed partial denture replacing a maxillary canine is subjected to more damaging stresses because the forces are directed outward & the pontic lies farther outside the interabutment axis



A fixed partial denture replacing a mandibular canine is more favorable as the forces are directed inward & the pontic is closer to the inter abutment axis

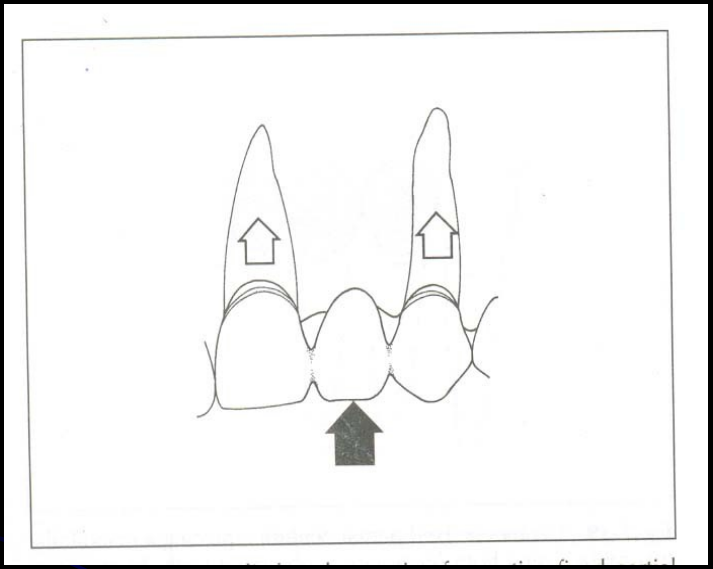
Canine replacement fixed partial denture

- Replacing maxillary canine is subjected to more stresses than mandibular ,since forces are transmitted outward (labially) as compared to mandibular

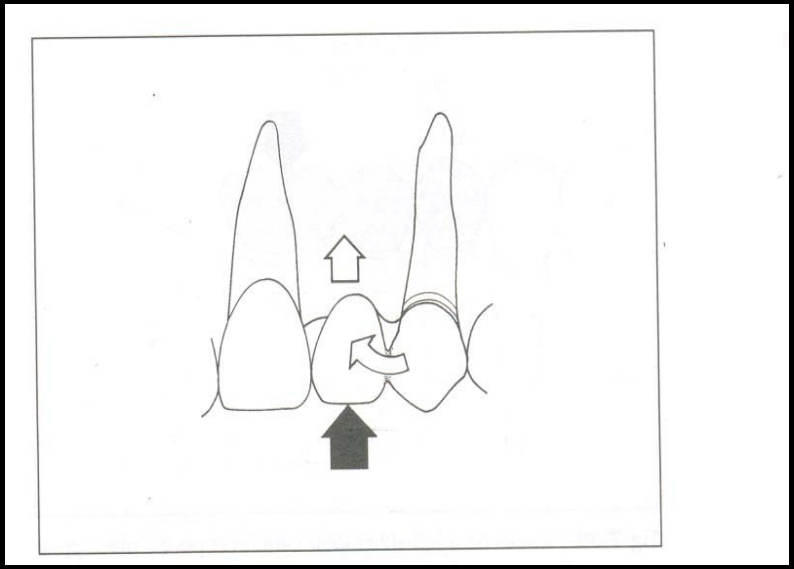
Cantilever fixed partial denture

- A cantilever pontic is the pontic which is supported only on one side
- The pontic acts as a lever that tends to be depressed under forces with a strong occlusal vector
- A classic fixed partial denture lateral incisor pontic

Cantilever fixed partial denture

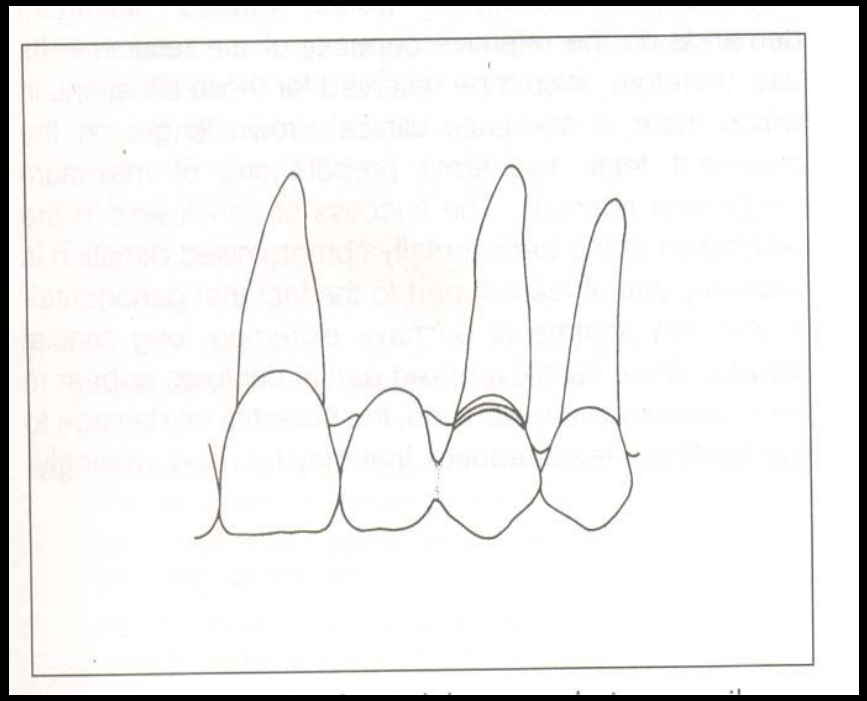


Forces applied to the pontic of a routine fixed partial denture are transmitted to both the abutment



Forces on the pontic of a cantilever fixed partial denture tend to tip the prosthesis or the abutment

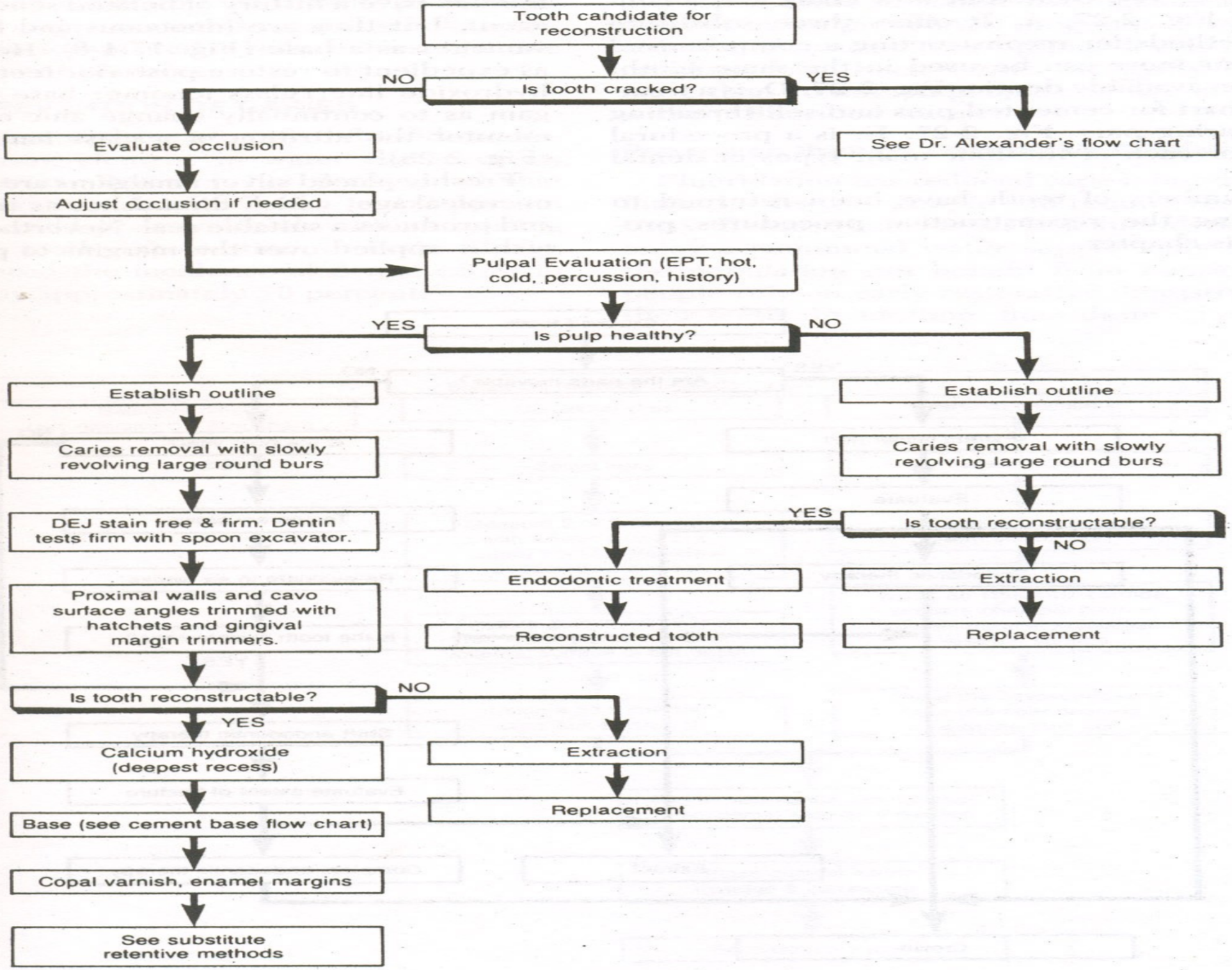
Cantilever fixed partial denture

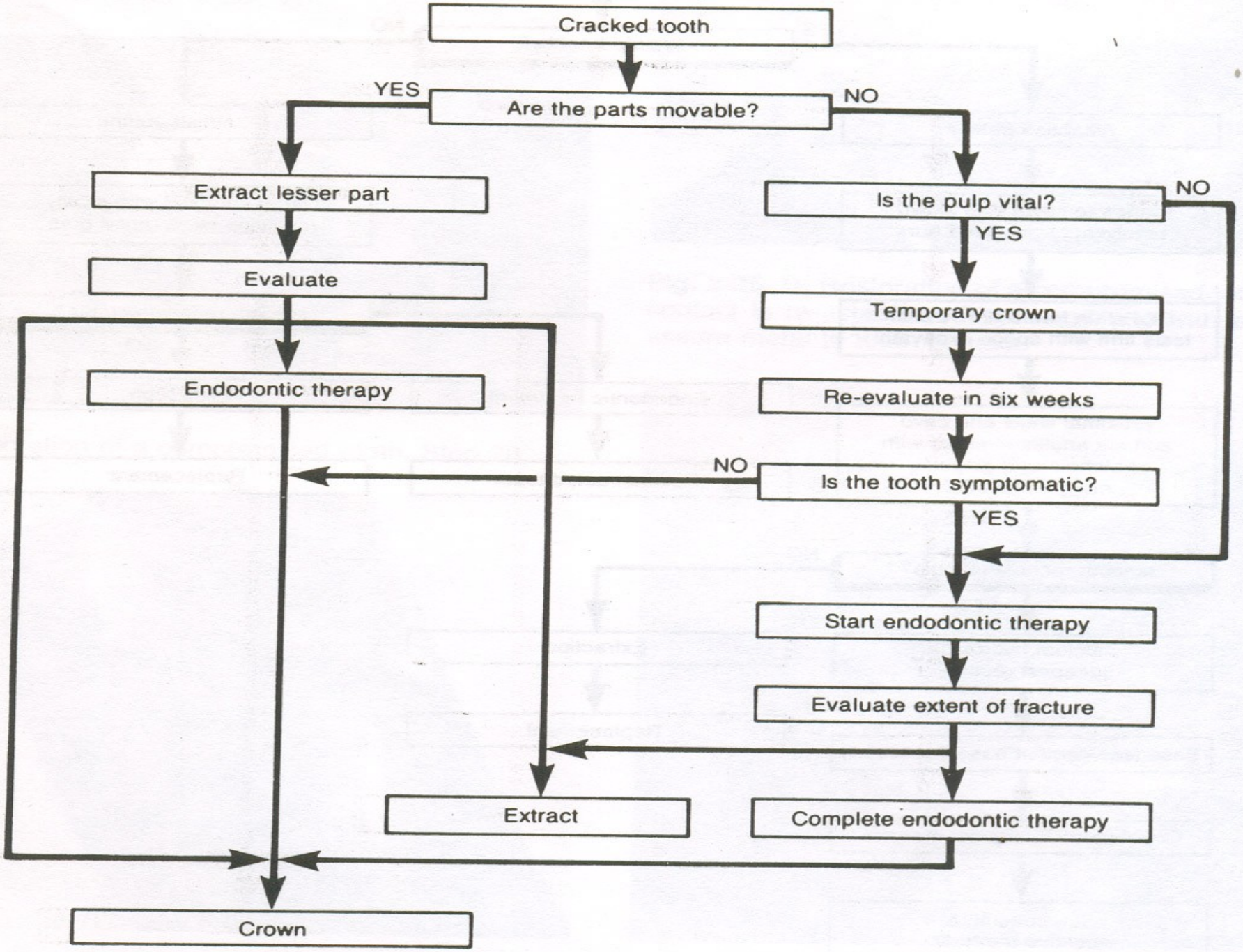


Cantilever fixed partial denture replacing a maxillary lateral incisor , using the canine as the abutment

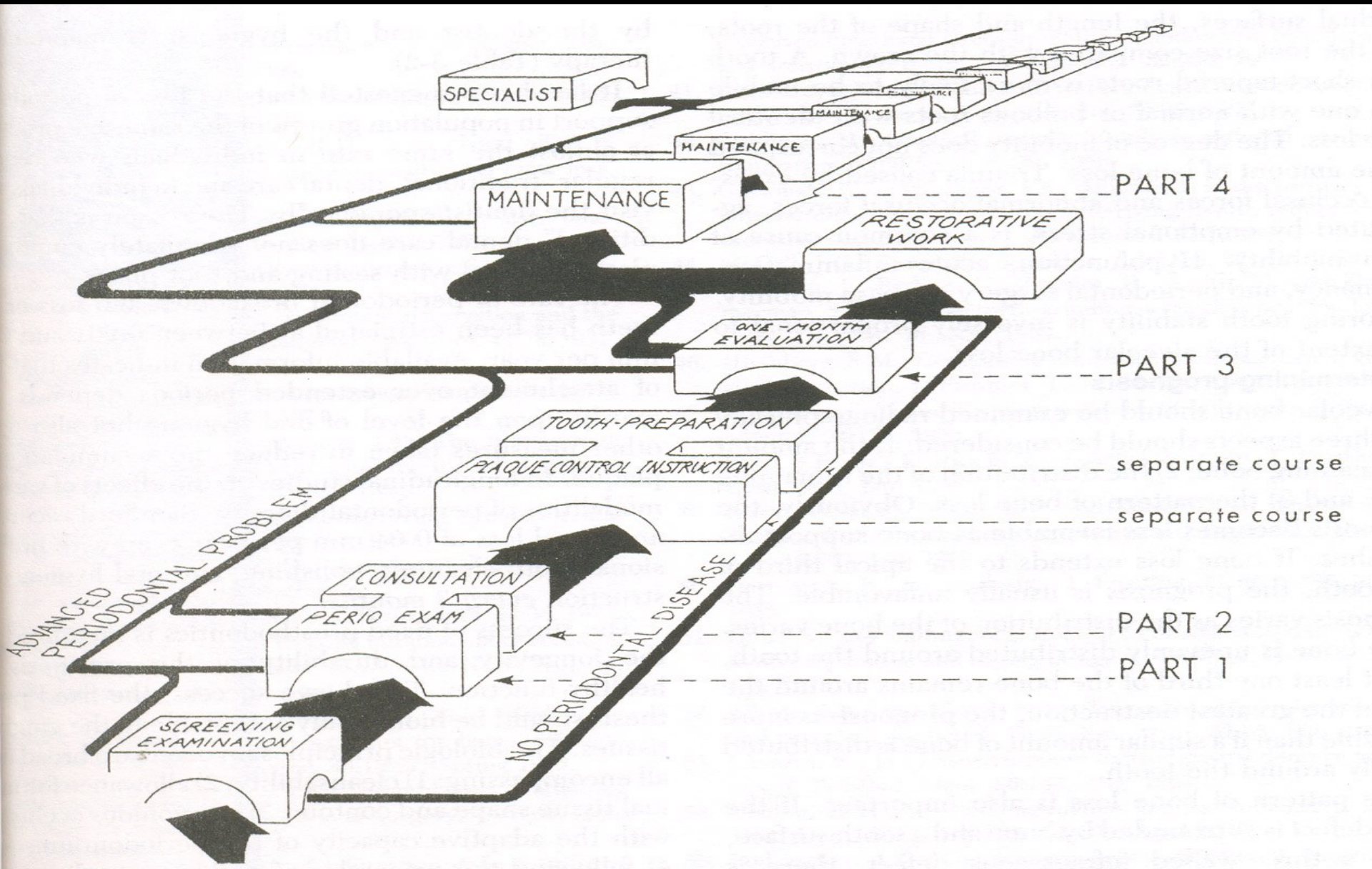
Available tooth structure & crown morphology

- The amount of sound tooth structure remaining for a proposed abutment will influence its selection
- Teeth with extensive defective restorations , carious lesions, or fracture may require an intentional endodontic therapy and post & core fabrication to provide a sufficiently retentive & resistance form to the preparations
- Crown lengthening may be indicated to expose sound tooth structure coronal to the biologic width when caries, restorations, or fracture are in proximity to the alveolar crest
- Crown morphology & quantity of sound enamel & dentin also influence the selection of teeth to be used as an abutment

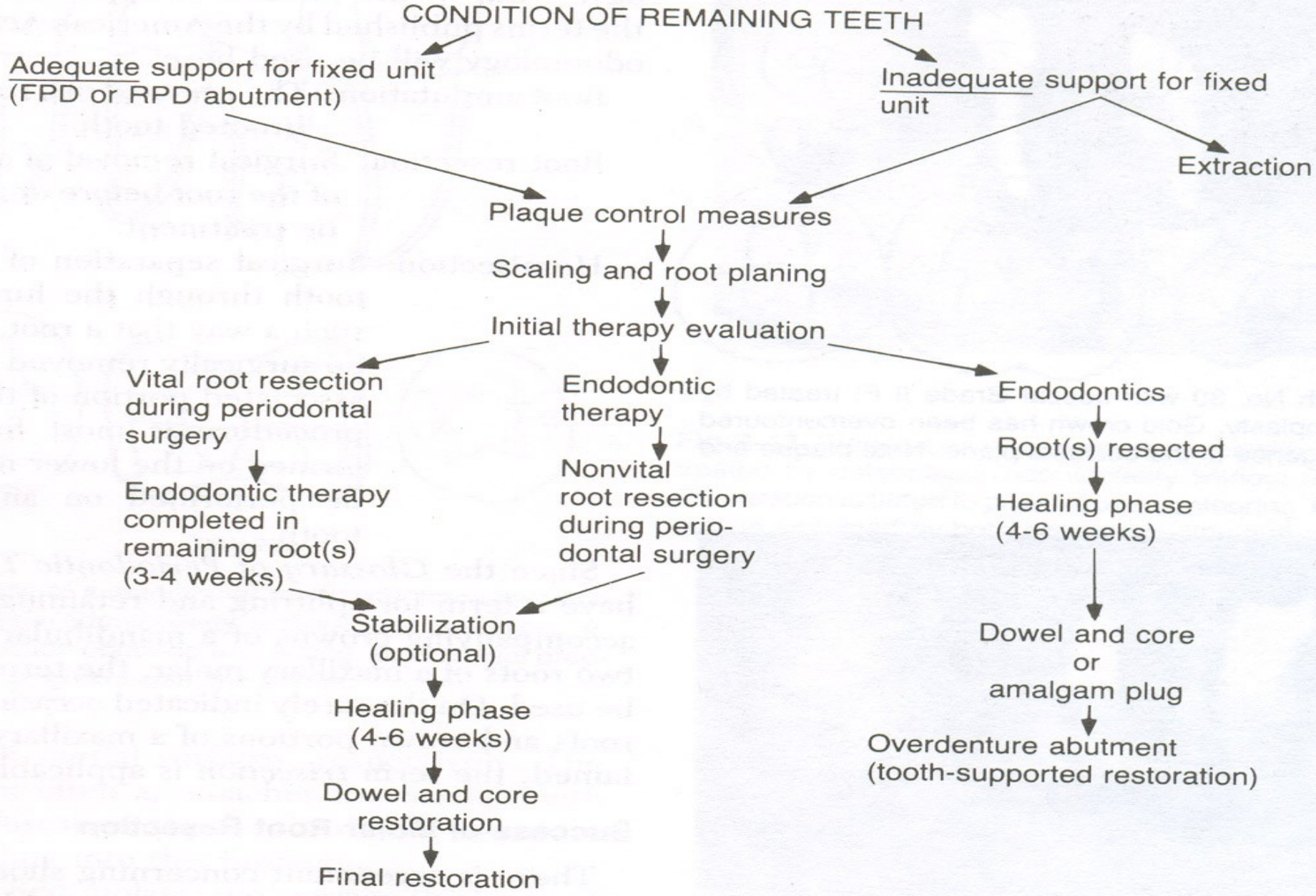

Tooth candidate for reconstruction
Is tooth cracked?
NO
YES
Evaluate occlusion
See Dr. Alexander's flow chart
Adjust occlusion if needed
Pulpal Evaluation (EPT, hot, cold, percussion, history)
Is pulp healthy?
YES
NO
Establish outline
Caries removal with slowly revolving large round burs
DEJ stain free & firm. Dentin tests firm with spoon excavator.
Proximal walls and cavo surface angles trimmed with hatchets and gingival margin trimmers.
Is tooth reconstructable?
YES
NO
Calcium hydroxide (deepest recess)
Base (see cement base flow chart)
Copal varnish, enamel margins
See substitute retentive methods
Extraction
Replacement
Establish outline
Caries removal with slowly revolving large round burs
Is tooth reconstructable?
YES
NO
Endodontic treatment
Reconstructed tooth
Extraction
Replacement


Cracked tooth
Are the parts movable?
YES
NO
Extract lesser part
Evaluate
Endodontic therapy
Is the pulp vital?
NO
YES
Temporary crown
Re-evaluate in six weeks
Is the tooth symptomatic?
NO
YES
Start endodontic therapy
Evaluate extent of fracture
Extract
Complete endodontic therapy
Crown

PERIODONTAL CONSIDERATIONS



DIAGNOSIS AND TREATMENT PLANNING FLOW CHART FOR TEETH WITH RESECTED ROOTS



CONCLUSION

- Many factors are considered before abutment selection & all these complex factors cannot be readily defined or positioned in order of their significance
- A periodic clinical & radiographic evaluation is imperative from prognostic point of view

- Selection of the abutment is the key point of success for fixed partial denture design
- It ultimately depends upon the clinical skill, judgment & experience of the dentist
- Gregory's observation "After Years Of Practice, Each New Case Is A Variation Of One Previously Handled "

REFERENCES

- Tylman's Theory & Practice Of Fixed Prosthodontics
- Fundamentals Of Fixed Prosthodontics – Shillingburg
- Contemporary Fixed Prosthodontics – Rosenstiel
- Planning & Making Crowns & Bridges – B.Smith

Thank You