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REVIEW ARTICLE

Long Span Fixed Partial Denture - A Review

Asish Kumar Barui[1], Tapan Kumar Giri[2], Sugata Mukherjee[3], Anindita Majumder[1], Abhisek Chowdhury[1]

[1]Post graduate student, [2]Professor and Principal, [3]Professor and Head of Department, Department of Prosthodontics Crown and Bridge, Dr. R. Ahmed Dental College and Hospi- tal, Kolkata. Email Id: goggle011@gmail.com.

Abstract

Prosthetic rehabilitation of a long span partially edentulous ridge is a challenging job. A systematic and rational approach is required to treat this situation. Most of the cases patients with long span partially edentulous arches desire fixed prosthesis over a removable one. But complex biomechanics, condition of remaining abutment teeth make it difficult to fabricate a fixed prosthesis. This article discusses about the indications, advantages, limi- tations of a long span fixed partial denture so that whenever we plan for this kind of prosthesis it should have a long term prognosis without failure. (2019, Vol. 03; Issue 01: Page 7 - 12)

Key Words: Long span edentulous arch, Fixed prosthesis, Abutment, Biomechanics.

Introduction

Partial edentulism is a situation where one or more but not all natural teeth are ab- sent. Partial edentulism leads to several drawbacks of the subjects including clini- cal challenges and lifestyle compromises. Clinically partial edentulism results in drifting and tilting of adjacent teeth, supra eruption of opposing teeth, altered speech, changes in facial appearance and tem- pero-mandibular disorders. Prosthesis is an artificial replacement of a part of the human anatomy and thus restores form, function and esthetics of that lost or miss- ing part (1). Long span fixed partial pros- thesis is a situation where more than two teeth have to be replaced and more than one abutment has to be taken for support on either side (2). It's the number of units that determine the long span. A fixed pros- thesis has several advantages over remov- able one i.e. patients feel like natural teeth, less prosthetic maintainance, less alveolar bone loss etc (1, 2). The distance between abutment teeth affects the feasi- bility of placing a fixed prosthesis. De- pending on number of remaining natural teeth, anatomical condition and periodon- tal health of natural teeth, position of edentulous arch, biting force, residual al- veolar bone quality and quantity, finan- cial condition of patient etc. a conven- tional tooth supported or implant sup- ported FPD has to be considered. The goal of prosthesis is to establish a state of functional as well as biological efficiency without compromising esthetics (3). The treatment plan should begin with end in the mind.

Long span fixed partial denture prosthesis can be divided mainly into two types- A.

implant supported fixed prosthesis, B. tooth supported fixed prosthesis.

Implant supported fixed partial denture

- Distal extension edentulous area or edentulous arch with less no of remain- ing natural teeth where conventional tooth supported FPD is not possible, an implant supported fixed prosthesis can be a better option over removable one (4).
- To replace missing both mandibular 1st and 2nd premolars and 1st molar, a conventional tooth supported fixed par- tial denture should be avoided here be- cause of insufficient interarch space and direction of occlusal force against the inner curvature of occlusal plane will lift the retainer (1).
- Splinting of dental implant restorations reduce rotational force, increase resto- ration strength and stress distribution (1, 2).

Factors considered for implant supported FPD

1. Mandibular movements- Following points should be considered during evalu- ating the effect of mandibular movements on FPD -

i. Flexion- The flexure of the mandible during opening and protrusive movements occurs distal to the mental fo- ramina as a result of the internal pterygoid muscle attachments on the ramus. Me- dial movement from the first molar to the first molar region may be 800 microns (4) (Fig 1).

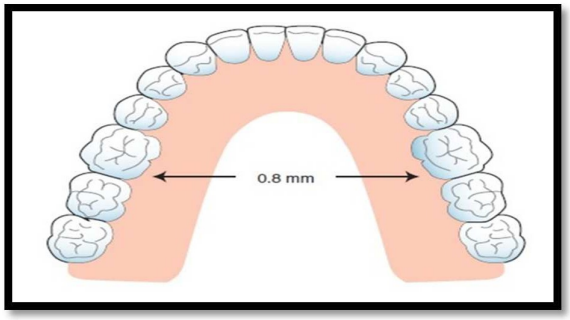

Fig 1: The flexure of mandible during opening and protrusive movements

ii. Torsion – The mandible also tor- ques, with the inferior border rotating out and up and the crestal region rotating lin- gually. The movement is caused by the masseter muscles during forceful biting or parafunction (4) (Fig 2).

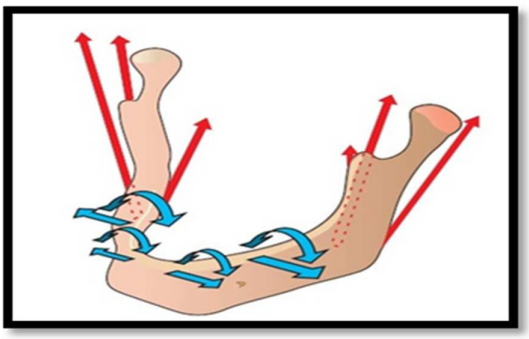

Fig 2: Mandibular rotation

iii. Complete cross-arch splinting - Complete cross arch splinting of posterior molar implants with a rigid, fixated pros- thesis should be avoided in the mandible. There is an increase in flexure in the pos- terior mandible as mental foramen weak- ens the facial cortical plate. Posterior rigid, fixated implants splinted to each other in a full – arch restoration are subject to a considerable buccolingual force on open- ing and during parafunctional movements (4, 5) (Fig 3).

Fig 3: OPG shows that all implants in the anterior and one posterior side are splinted together for a seven unit fixed prosthesis. The other posterior segment is restored separately with an independ- ent three unit implant supported fixed prosthesis.

2. A-P Spread - The antero–posterior spread also has an important influence on the prognosis of FPD. The distance from the center of the most anterior implant to a line joining the distal aspect of the two most distal implants on each side is called the anteroposterior (A-P) distance or the A-P spread (Fig 4).

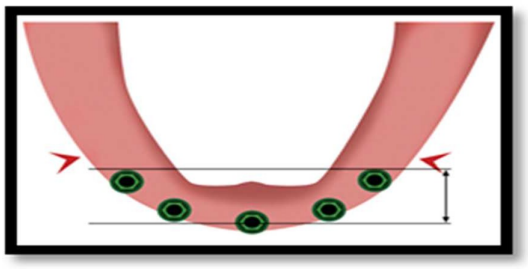

Fig 4: The anteroposterior (A-P) distance

The greater the A-P spread, the farther the distal cantilever may be extended to re- place the missing posterior teeth. As a general rule, the cantilever should not ex- ceed 2 times the A-P spread, with all other stress factors being low (4).

A-P spread is only one of the force factors to be considered for the extent of the distal cantilever. If the stress factors are high (e.g., parafunction, crown height, mastica- tory musculature dynamics, opposing arch), the cantilever length of a prosthesis should be reduced and may even be con- traindicated. The density of bone is also an important criterion. The softest bone types (D3 and D4) should not have as great of a cantilever than the more dense types (D1 and D2) (4, 6).

Tooth supported fixed partial denture

Following factors should be considered for long span fixed partial denture-

1. Biomechanics - Bending or deflection of prosthesis varies directly with the cube of length and inversely with the cube of the occlusogingival thickness of connector (Fig 5).

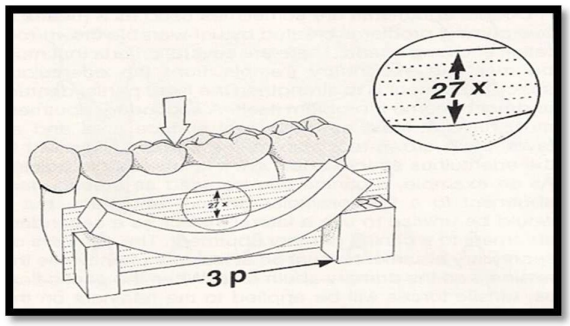

Fig 5: Deflection of a fixed dental prosthe- sis under load

To minimize flexing due to long span, pon- tic designs with a greater occlusogingival dimension should be selected and bio- material with high yield strength (eg. Nickel –chromium) is the material of choice to fabricate the prosthesis (1).

2. Arch curvature - Pontic acts as a lever arm when it lies outside the interabut- ment axis line. It can produce a torquing movement during occlusion, which is most common in replacing maxillary four

incisors. To offset the lever arm a counter balancing retention is provided by includ- ing 1st premolar as secondary abutment (3) (Fig 6).

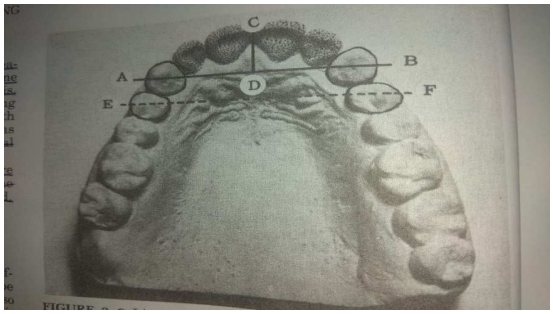

Fig 6: Maxillary incisors are missing and canines of both sides act as abutments, AB- inter abutment axis line, CD – lever arm length, ideally cd= bf.

3. Abutment evaluation -

a. Crown root ratio - The crown - root ratio is evaluated from radiological findings. The optimum ratio is 2:3 whereas 1:1 can be accepted for further treatment.

b. Root configuration - Configura- tion of roots is also an important factor. Roots with parallel sides and developmen- tal depressions are better able to resist heavy occlusal forces than smooth sided conical roots. Multirooted teeth generally provide greater stability than single rooted teeth.

c. Periodontal ligament area - Peri- odontal ligament area is also called root surface area or area of periodontal liga- ment attachment of the root to the bone. In 1926 Irwin H Ante presented in his pa- per that - *the total periodontal membrane area of the abutment teeth must be equal or exceed that of the teeth to be replaced. So root surface area is an important param- eter when long span FPD is considered (Fig 7A & B).*

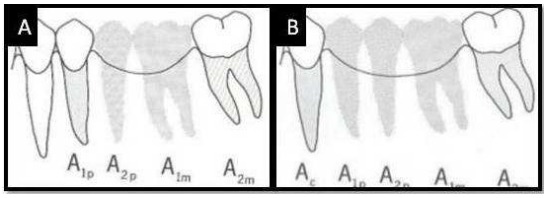

Fig 7: A- Combined root surface area of 1st PM and 2nd molar (A 1p +A2m) is nearly equal to combined root surface area of 2nd PM and 1st molar (A2p+A1m). FPD can be fabricated. B- If the combined root surface area of canine and 2nd molar (A c + A 2m) is lesser than combined root surface area of teeth being replaced (A1p +A2p+A1m). FPD should be avoided.

4. Span length - Longer the span of a bridge the greater will be the stress im- posed on the abutment teeth and on all components of a bridge i.e. pontics, re- tainer, connectors. To prevent periodontal overloading larger number of abutment teeth has to be selected. The components of bridge must be enough to bear heavy occlusal stress.

5. Biting force - Treatment planning and prognosis of long span FPD also depends on amount of biting force .Amount of bit- ing force also depends on whether it gen- erated by natural dentition or any pros- thesis, muscular activity, parafunctional habits etc. Excessive occlusal forces can cause loosening of the prosthesis through flexure or can cause fracture of ceramic components or tooth mobility.

6. Materials- Components (connectors, re- tainers, pontics) of long span FPD should be fabricated of materials with high yield strength to prevent flexion (eg. Nickel – Chromium).

7. Esthetics – In most situations FPD pro- vides the most esthetic means of replacing

missing teeth, provided no large defect in edentulous ridge is present (3, 4).

Clinical situations of replacing multiple teeth

A. Replacing Multiple Anterior Teeth - Special considerations in this situation in- clude problems associated with esthetics and requirement to resist tipping forces directed laterally.

When maxillary incisors are being re- placed forces directed against a maxillary incisor pontic will tend to tip the abutment teeth due to curvature of the arch.

Tipping forces must be resisted by means of two abutment teeth at each end of long span anterior FPD. Thus, when replacing four maxillary incisors, the clinician should generally use canines and first pre- molars as abutment teeth.

The four mandibular incisors can usually be replaced by FPD with retainers on each canine. It is not usually necessary to in- clude first premolars.

Limitation - In case of considerable ridge resorption and a need to leave diastema RPD is considered, dry mouth increases the risk of recurrent caries in tooth – res- toration margin (7).

B. Replacing Multiple Posterior Teeth - When replacing multiple posterior teeth, it is advantageous to restore the posterior segments at the same time as this leads to the development of an efficient occlusal scheme (8). Treatment of all four posterior segments together might lead to complica- tions and difficulties for the patient as well as the dentist. It is preferable to complete treatment of one side before starting treatment on the other side.

Limitation - Missing maxillary 1st pm, 2nd pm and 1st molar. FPD is possible only if the opposing occlusion is a removable par- tial denture and canine guidance is im- portant here (1).

Reasons of failure

1. In long span FPD flexion occurs that may cause cementation failure. Proper choice of retainer, rigidity of casting and cementation technique can prevent this failure (Fig 8A & B).

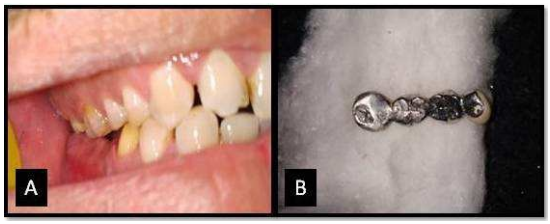

Fig 8: A- After removal of prosthesis, B- Failed fixed partial denture

2. Heavy occlusal force, internal porosity may lead to connector failure.
3. Improperly designed occlusal scheme may cause heavy oblique force on pontic as well as abutment and ultimately failure of the prosthesis
4. Periodontal breakdown – The break- down of periodontal apparatus occurs mainly due to poor bridge design, incor- rect assessment of number and strength of abutments (4, 9) (Fig. 9)

Fig 9: OPG shows severe bone loss around abutment teeth

Discussion

Fixed prosthodontic treatment becomes more difficult when several teeth must be replaced9. Different kinds of problems are encountered in restoring a single long span uninterrupted edentulous area or multiple edentulous areas with intermedi- ate abutment teeth. Underestimation of the problems involved in extensive pros- thodontic treatment can lead to failure. One key to ensuring a successful result is to plan the prosthesis by diagnostically waxing the intended restorations on artic- ulated diagnostic casts. This is essential for complex fixed prosthodontic treat- ments, particularly when an irregular oc- clusal plane is to be corrected, the occlu- sal vertical dimension is to be altered or implant supported prosthesis is recom- mended (10). The precise end point of such complicated treatments can be far from evident, even to an experienced clini- cian.

Conclusion

Rehabilitation of a long span edentulous arch with fixed dental prosthesis is a com- plex procedure. The success of a treat- ment depends on careful planning which involves proper clinical examination, radi- ographic examination of abutment teeth and alveolar bone, along with a consider- ation of full mouth study casts. A fixed dental prosthesis is always a better option in compare to removable prosthesis. Con- trary to popular belief cost is never a de- ciding factor if we can highlight the ad- vantage to a patient.

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