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In vitro study of stress transmitted to abutment teeth of distal extension R.P.D retained by L-clasp different design origination of bar clasp

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Abstract:
Purpose: The goal of this study was to evaluate and compare stress transmitted to abutment tooth of distal extension removable partial denture retained with L-bar clasp – In vitro study of different origination of bar clasp to abutment tooth.**Materials and Methods:** Partially edentulous acrylic resin mandibular model of bilateral distal extension ridge with remaining teeth from first premolar to first premolar will be fabricated and duplicated to fifteen models. Poly vinyl silicon impression material will be packed to simulate mucosa covering distal extension ridge. Removable partial denture frame work will be fabricated with L-bar clasp placed on distal abutment, lingual bar major connector, mish-work retentive minor connector and cinglum rest on canine that act as indirect retainer. **Results:** The results of mean µ strain comparison between studied groups at buccal, distal and lingual in bilateral loading. There was a statistically significant difference among the studied groups with higher mean µ strain at group 3 followed by group 1 then group 2.
Key words: RPD,RPI clasp, RPL clasp.

Introduction

Distal extension removable partial dentures (RPDs) are supported and retained against functionally displacing forces by two structures that differ markedly in their visco-elastic nature of the residual ridge.

The most significant factor in selection of bar clasp still remains the location of the retentive area. When the survey line indicate that the retentive arm is located in the center" miso distal" contour or buccal or lingual surface of the tooth adjacent to edentionlous area.[1] Hence, rehabilitation with distal extension RPD necessitates precise partial denture design following biomechanical principles and considerations. Forces that produce torque on abutment teeth should thus be controlled and minimized when designing RPDs. Bar clasp (T-bar, modified T bar &I clasp) are suitable where the retentive area on the abutment tooth is located near the edentulous area [2].

Greater controversial for designing the T-clasp to engage the mesial undercut of abutment teeth adjacent to distal extension base. However the T-clasp is designed for both mesial and distal undercut according to the contour of the tooth. It is well- known T-clasp should not be used with distal extension base when the retentive undercut are located away from edentionlous area. A modified T-clasp (L- clasp) is basically a T-clasp with omitted finger. The clasp is indicated for premolars & canines for esthetic reason [3].

The L-bar originates at the mesiobuccal line angle of the abutment tooth with L form lies in the undercut "distobuccal" while the far portion (bracing area)is situated above the survey line of abutment teeth. When a mesial occlusal rest is used encirclement is more apt to be complete without the anterior portion of the teeth and it may be eliminated [3]. L-bar arm is proposed to disengage the tooth when rotation of the denture occur around the mesiocclusal rest [4].

Alternatively the retentive terminal may be ideal placed distally to engage the distal undercut near to the saddle. This In vitro study aimed to study stress transmitted to abutment tooth of distal extension removable partial denture regarding origination of L-bar clasp from center or mesial contoured of abutment tooth.

Material and Method

An educational partially edentulous mandibular model was constructed with symmetrical Kennedy class I containing artificial teeth extending from the first premolar on one side to the first premolar on the other side. The model was fabricated from duplicating an involving complete set of artificial teeth with anatomical roots that allow easy insertion and removal of the individual tooth from the model. Educational dental model was modified by removal of second premolars and molar teeth and contouring the ridges by wax. The acrylic resin teeth were removed from the model and the root portions of teeth were wrapped with 0.3 mm thick aluminum foil spacer for simulation of the periodontal ligament [5]. The teeth were repositioned in their indentations in the putty mold then were fixed with sticky wax. Molten wax was poured into the putty mold. The wax model was trimmed and finished, then it was flasked and packed into transparent heat cured acrylic resin. The socket filled with polyether impression material then the teeth were repositioned after removal of tin foil spacer. The tin foil spacer were adapted and contoured to modified acrylic resin ridge. Standardized 2 mm thickness of simulating mucosa was fabricated **(**Fig 1). The Acrylic Model was surveyed to determined retentive parallism of the guiding plane, height of contour and retentive undercut.

Removable partial denture frame work will be fabricated with L-bar clasp placed on distal abutment, lingual bar major connector, mish-work retentive minor connector and cinglum rest on canine that act as indirect retainer.

Mandibular distal extension removable partial denture will be classified equally according to the design of L-bar clasp into three groups. For group A,where bar clasp originated from the center of the mesio- buccal contour of the abutment tooth and retentive finger engage the distal under cut. For group B,where bar clasp originated from the center of the mesio- buccal contour of the abutment tooth and retentive finger engage the mesial under cut. For group C, where bar clasp originated from mesial contour and retentive finger engage the distal undercut (Fig 2).

Abutments preparation: On the identical acrylic model, mesial saucer shaped occlusal rest seats were prepared in model mandibular first premolars and proximal guiding planes with 1.5 mm occluso-gingival height on distal aspect. Cingulum rest seat in canines bilaterally. Retentive under cut will be prepared at the distobuccal line angle near to the saddle for groups A and C, and at the mesiobuccal line angle away from the saddle for group B. Condensation silicon impression was made by acrylic resin Accustom impression tray and poured in to dental stone to construct three master cast. Three mandibular master cast was surveyed. The wax pattern were casted with chromium cobalt alloy to produce five metallic frame work for each group were fitted in the corresponding master cast.should be Standardization of arrangement of artificial teeth and denture base.

Stress Analysis by using electrical strain gauges: Three strain gauge positioned around each abutment distally, buccally and lingually. Strain gauges connected to Wheatstone bridge** and digital strainmeter.

Load application and Strain measurement: Each model was located on platform of the universal testing machine* was used to apply a vertical static load in the equal magnitude on the selected loading points at the central fossa of the first molar .

-**Bilateral (central) load application:** A vertical static load of 100N magnitude was applied at midpoint pit of the crossing bar. Consequently, the load applied on the first molar on each side was 50 N. All measurements were repeated 5 times for each loading impact.

Unilateral axial loading: applied in central fossae of 1st molar on right and left side (Fig.3).

Fig.1 Standardized 2 mm thickness of simulating mucosa was fabricated.

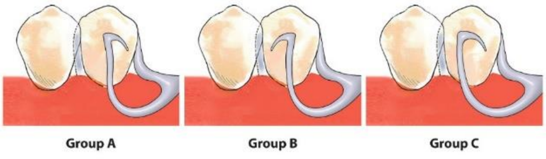

Fig. 2: The diagram which illustrated the design of three groups.

Fig.3: Unilateral axial loading at central fossa of 1st Molar.

Results: Table (1): Comparison of mean µ strain between loaded and unloaded sides in unilateral loading in all studied cases.

All groups	Unilateral		Test of significance
	Loaded Mean±SD	Unloaded Mean±SD	
Distal	43.27±15.7	12.47±3.2	t=7.45 p<0.001*
Lingual	25.2±7.68	8.27±2.46	t=8.13 p<0.001*
Buccal	47.87±15.03	14.33±4.01	t=8.35 p<0.001*

*t:Student t test p:probability * statistically significant (P<0.05)*

Table : show student t test results of mean µ strain comparison between unilateral loaded and unloaded sides in all cases. *At distal side* there is a statistically significant difference between loaded and unloaded sides (p<0.001) with higher mean µ strain at loaded side than unloaded side (43.27±15.7 versus 12.47±3.2, respectively). *At lingual side* there is a statistically significant difference between loaded and unloaded sides (p<0.001) with higher mean µ strain at loaded side than unloaded side (25.2±7.68 & 8.27±2.46, respectively). *At buccal side* there is a statistically significant difference between loaded and unloaded sides (p<0.001) with higher mean µ strain at loaded side than unloaded side (47.87±15.03 & 14.33±4.01, respectively).

Discussion: This research found that abutment root surface of the loaded side of RPD retained with L bar clasp with different origination was significantly subjected to more µ strain compared to that of unloaded side. This result is explained that, unilateral loaded responsible greater stress transmitted to the loaded side compared to unloaded side as result of rotation of the prosthesis " toward the loaded side" along the center of the dental arch.

Different retainer influenced the occlusal load distribution. In other word, some force transmitted to the abutment on the side opposite the application of vertical force. the rigidity of major connector allows stresses that applied to any portion of RPD is distribute over the supporting area including abutment teeth and under lining bone[6].

In Group B and C the µstrain in unilateral loading is greater than bilateral one because of unilateral despite stress from loaded site to unloaded loading to reduce stress recorded on the loading by strain gauge measuring on Other hand bilateral loaded there is no dissipating of load from one site to other, the calculated load is really of that applied load this explain the bilateral was significantly greater than unilateral loaded was significantly greater than unilateral load. [7]

When comparing group A, B and C to gather at distal, buccal and lingual sides either bilateral or unilateral load there was higher mean µ strain at group A followed by group C and the lowest one is group B. For group A, part of retentive arm above the survey line ,prevent complete gingivally disengagement of retentive terminal of modified T-clasp that engage distal undercut (undercut near to the saddle) leading to excessive stresses transmitted to abutment teeth .[8]

On other hands, for group C where retentive arm originated from mesial part of abutment teeth , the un complete disengagement of retentive terminal of modified T-clasp is compensated by long arm concept compared to that of group A that enhance arm flexibility by the this mean less stresses applied to the abutment under functional loading of the prosthesis.[9]

Conclusion:

Within the limitation of this In vitro study:

1- L-Bar clasp origination proved to has an important role in transmitting the stresses to the abutment teeth.

2- Engaging the retentive undercut, away from the edentulous ridge by using L-Bar clasp dramatically reduce the stresses on the abutment teeth

3- Engaging the distobuccal retentive undercuts by L-Bar clasp could be destructive to peri-abutment tissues by its forward movement in bilateral distally extended RPDs.

Recommendations:

Further In vitro and clinical studies are recommended to assess the Mechanical and biological effects of L-bar clasps that engage retentive undercuts away from edentulous ridges of distally extended RPD.

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