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RESEARCH ARTICLE

RADIOGRAPHIC EVALUATION OF TELESCOPIC PIER ABUTMENTS IN MANDIBULAR DISTAL EXTENSION CASES

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Abstract

Purpose: The aim of this clinical study is to compare the effect of both definitive partial dentures and telescopic partial dentures on bone height changes around the terminal abutments in mandibular distal extension cases with pier abutment.

Materials and Methods: Fourteen mandibular Kennedy's Class I classification with pier abutment patients were divided into two equal groups. First group (I) received definitive metal-frame removable partial dentures (RPD), while the second group (II) received telescopic RPD. The supporting bone height around the terminal abutments was radiographically evaluated. Next to baseline recording following denture insertion, bone height measurements were obtained at regular recall follow-up appointments of 6, 12, 18 and 24 months. Radiographic evaluation was carried out using the Digora system and customized acrylic template constructed for each patient individually. The linear measurement system supplied by the Digora machine software was utilized for recording bone height changes mesial and distal to the main terminal abutments.

Results: Comparison was performed between definitive and telescopic groups utilizing independent t-test and resulted in differences of no significant for all follow-up recalls (P value > 0.05).

Conclusion: Definitive RPD and telescopic RPD appeared to be successful both clinically and biologically. However, Telescopic RPD proved to be superior to the definitive one regarding bone height measurements.

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Introduction:-

Handling worries accompanied by distal extension base cases is remarkably happening. This is attributed to obscurity of subsequent abutments and alteration of support among the abutment tooth's periodontal ligament and mucoperiosteum layering the edentulous ridge. Sequentially, disproportionate torque on the supporting teeth is exerted resultant from denture base rotation beneath loading foremost to their premature damage⁽¹⁾.

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Moreover, incidence of intermediate pier abutment might be problematic and employing either fixed or removable partial denture aid in resolving such situation. Both dropping the potentially extreme strain and monitoring the torque forces acting on pier abutments are forms of sundry recommended trials ⁽²⁾.

A distinct form of the conservative modalities employed for handling Kennedy class I cases with pier abutment is removable partial denture with cast metal framework. Conventional concept of support ought to be approached by stress abating through residual alveolar ridge's provision manipulation, appropriate border molding and piling the altered cast procedure's impression ⁽³⁾.

Furthermore, telescopic crown retained removable partial denture is an auxiliary chance affording reasonable support and retention together with safeguarding the surrounding supporting structures ^(2 & 3).

Ethical considerations:

At beginning of the study, patient's data (personal, medical and dental) were collected according to the implemented rules of research ethical committee of NRC, and written consents were obtained from the participating patients.

All patients were informed about the practical steps of this study and the follow – up period and they signed the approval consents.

Material and Methods

For the current contemplate fourteen patients were nominated from the Outpatient Clinic of the Prosthodontic Department, Faculty of Oral and Dental Medicine-Cairo University according to the following criteria: Mandibular Kennedy's class I patients with unilateral pier abutments, within 40-50 years of age and exempted from bad oral habits as (bruxism or clenching).

The edentulous area was morphologically regular, shielded with healthy firm mucosa, exempted from any signs of inflammation or flabby tissue and all their abutments were adequately bony supported. The carefully chosen cases had a preceding knowledge in oral prosthodontics and those with super erupted, malaligned and tilted teeth were totally evaded.

Patient examination and case preparation

Full medical and dental history of the patient were documented together with proper clinical examination was performed both visually and digitally. Periodontal treatment, restoration and extraction of all the remaining, carious and badly decayed teeth was carried out respectively.

A. Patient's Grouping

Subjects were randomly divided into two equal groups, each of seven patients:

Group I: Patients received conventional bilateral removable partial denture



Figure 1: Metal Framework

The usual sequence for removable partial denture construction took place starting from primary impression till mouth preparation was performed intraorally according to the design.

a) Partial Denture Design

Same design was utilized for group I cases with two RPI clasps; one on the last standing premolar on one side, while the other was placed on the canine mesial to the edentulous space and preceding the pier abutment. Moreover, lingual bar major connectors with two occlusal rests on the lonely standing pier abutment were employed. The canine's mesial surface received the cingulum rest, while the mesial one was located on the last standing premolar of the other side. Combination of metal and Acrylic resin (Acrylic resin attached mechanically to

the meshwork of the metal framework) took place by making secondary impression followed by cobalt chromium framework fabrication, then tried intraorally. Altered cast impression was made using zinc oxide and eugenol paste, Centric occlusal relation record was registered by employing wax wafer technique. Setting up of acrylic resin teeth was carried out then waxing-up of the denture was accomplished followed by denture try-in. Flasking, packing, processing, finishing and polishing were performed to make the partial denture ready for the insertion appointment.

Group II: Patients received telescopic retained removable partial denture



Figure 2: Telescopic removable partial denture metal framework

The three abutments were prepared by creating a deep chamfer finishing line with sufficient occlusal (2-2.5 mm) and axial (1-1.5 mm) reduction to accept the primary and secondary copings. A separate removable die was gained by cast sawing, then wax pattern was built then milling took place. This was accompanied by; spruing, investing, burning-out and casting into Co-Cr alloy. The primary coping was then finally cemented by aid of glass ionomer cement. Final ridge, primary coping and the prepared abutment impression was fabricated by using medium rubber base impression material. Secondary copings' wax pattern and removable partial over-denture framework was constructed, invested and casted by means of Co-Cr alloy. Altered cast impression was finally obtained by employing zinc oxide and eugenol and wax wafer technique was utilized to get centric occlusal record.

B. Radiographic evaluation of bone height

- 1) Identical digital images for all abutments were obtained and the mandatory bone extent was calculated by employing image processing software for Digora computerized system.
- 2) Radiographic template was constructed to contact the sensor holder in a spot lingual to the chief abutments and parallel to their long axis. Sequentially this standardized the relation between the abutment, sensor and the perpendicular cone at each time of exposure. The sensor was implanted into its protective cover and mounted to the sensor holder bite block, then properly attached to the radiographic template of the patient, figure (3).

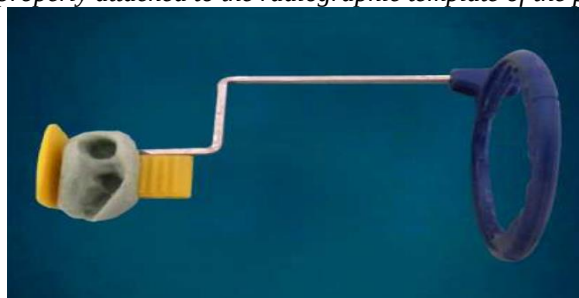


Figure 3: Radiographic stent.

The radiographic template in conjunction with the bite block carrying the sensor was inserted intraorally and assembled to plastic aiming ring at the terminal end of the long cone x-ray tube.

The sensor was exposed by the orix x-ray machine at 70 kilovolt, 11 milliamperere for 0.04 seconds; these parameters were fixed for all patients throughout the study period.

The template and sensor were then detached from the patient's mouth and the cover respectively, introduced into the scanner then reading out initiated automatically. Then the image was displayed on the computer screen and saved on previously prepared patient. Finally, the saved images of each patient were interpreted at the end of the follow up period.

Bone Height Measurement

Marginal bone height both mesial and distal to the pier abutment and distal to last one was assessed by employing linear measurement system supplied by the special soft-ware of the Digora device.

Calibration for the loss in marginal bone height required drawing three lines; a line passing tangential to the top of the pier abutment and two lines parallel and next to its both sides (mesial and distal) from a fixed point at the tangential line and incline perpendicular towards the highest level of the alveolar bone. The alveolar bone loss was verified by calibrating the distance along the two parallel lines in both sides (mesial and distal).

RESULTS

This contemplate was classified as case-control study and was performed to evaluate amount of bone resorption regarding bone height for dissimilar partial denture frameworks during twenty-four months follow-up period, between group I and II both mesial and distal to pier abutment.

Measurements were taken for each group, while both mean and standard deviation were calculated for further statistical consideration. Exploration of data in table (1) and (2) revealed normally distributed values employing Kolmogorov-Smirnov normality test as P-value > 0.05.

Regarding bone resorption's expanse mesial to pier abutment independent t-test for comparison between both groups was utilized. This sequentially revealed remarkable variance between groups at different follow-up periods as (P value < 0.05), listed in table (3) and displayed in figure (1). While distal to pier abutment the amount of bone resorption displayed noteworthy difference between both groups at diverse continuation periods as (P value < 0.05) utilizing independent t-test, listed in table (4) and showed in figure (2).

Table (1): Normality Test of Studied Values for Group I and Group II Mesial to Pier Abutment:

		Kolmogorov-Smirnov									
		Group I (Conventional)					Group II (Telescopic)				
		At Insertion	Six Months	Twelve Months	Eighteen Months	Twenty-Four Months	At Insertion	Six Months	Twelve Months	Eighteen Months	Twenty-Four Months
Bone Height	N	8	8	8	8	8	8	8	8	8	8
	Mean	14.52	14.39	14.32	14.25	13.95	13.2	13.11	13.1	13.05	12.86
	SD	3.99	3.95	3.93	3.91	3.83	3.63	3.60	3.60	3.58	3.53
	Normality Output	Data set with a p-value > 0.05 rejects the null hypothesis that the data are from a normally distributed population									

N; Number, M; Mean, SD; Standard deviation

Table (2): Normality Test of Studied Values for Group I and Group II Distal to Pier Abutment:

		Kolmogorov-Smirnov									
		Group I (Conventional)					Group II (Telescopic)				
		At Insertion	Six Months	Twelve Months	Eighteen Months	Twenty-Four Months	At Insertion	Six Months	Twelve Months	Eighteen Months	Twenty-Four Months
Bone Height	N	8	8	8	8	8	8	8	8	8	8
	Mean	15.67	15.5	15.4	15.22	14.78	14.72	14.6	14.55	14.48	14.16
	SD	5.01	4.96	4.93	4.87	4.73	4.71	4.67	4.66	4.63	4.53
	Normality Output	Data set with a p-value > 0.05 rejects the null hypothesis that the data are from a normally distributed population									

N; Number; Number, M; Mean, SD; Standard deviation

Table (3): Comparison between group I and group II during twenty-four months follow up period Mesial to Pier Abutment:

	Mesial to Pier Abutment				
	Group I (Conventional)		Group II (Telescopic)		P-value
	MD	SD	MD	SD	
Insertion to Six Months	0.13	0.03994	0.09	0.027651	0.0353**
Insertion to Twelve Months	0.2	0.061446	0.1	0.030723	0.001**
Insertion to Eighteen Months	0.27	0.082953	0.15	0.046085	0.003**
Insertion to Twenty-four Months	0.57	0.175122	0.34	0.104459	0.0065**

MD; Mean Difference, SD; Standard deviation, P; Probability Level

**significant difference.

Table (4): Comparison between group I and group II during twenty-four months follow up period Distal to Pier Abutment:

	Distal to Pier Abutment				
	Group I (Conventional)		Group II (Telescopic)		P-value
	MD	SD	MD	SD	
Insertion to Six Months	0.17	0.052229	0.12	0.036868	0.0439**
Insertion to Twelve Months	0.27	0.082953	0.17	0.052229	0.0119**
Insertion to Eighteen Months	0.45	0.138254	0.24	0.073736	0.002**
Insertion to Twenty-four Months	0.89	0.273436	0.56	0.17205	0.0118**

MD; Mean Difference, SD; Standard deviation, P; Probability Level

**significant difference

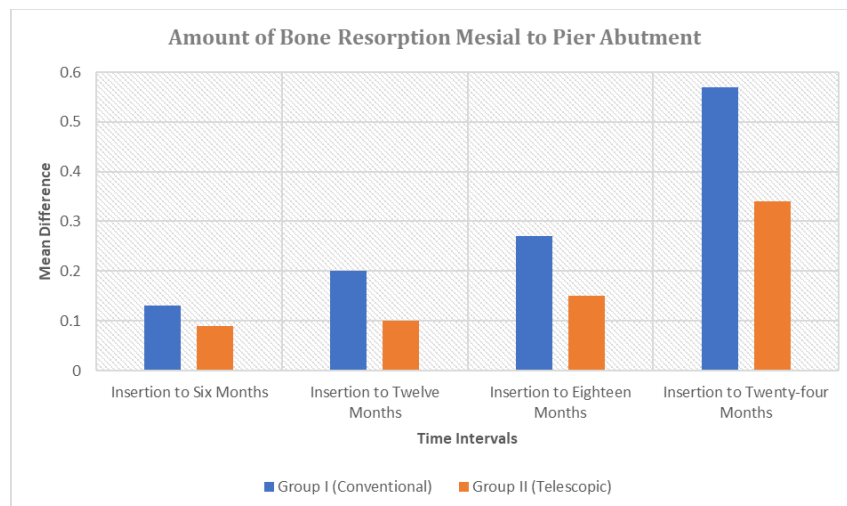


Figure (1): Bar Chart Comparison between group I and group II during twenty-four months follow up period Mesial to Pier Abutment

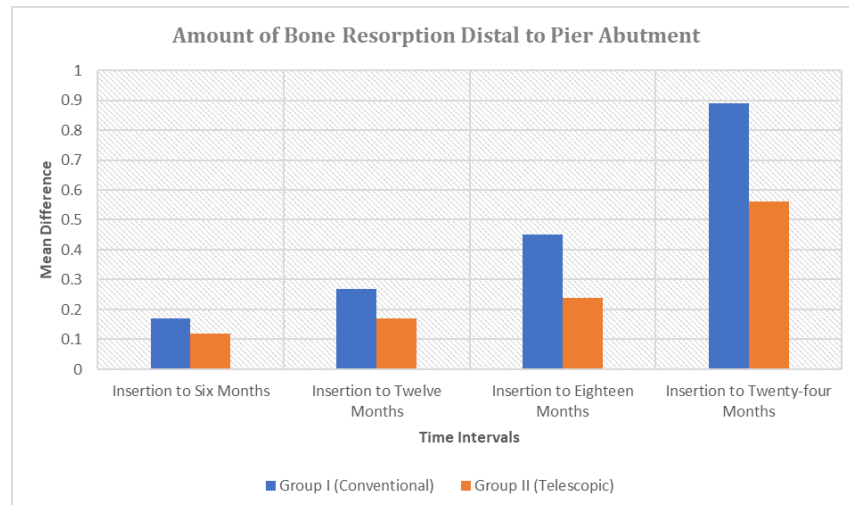


Figure (2): Bar Chart Comparison between group I and group II during twenty-four months follow-up period Distal to Pier Abutment

DISCUSSION

Middle aged females were the candidates for this contemplate to evade the impact of post-menopausal syndrome on both bone behavior and healing next to surgery. Additionally, females beneath that age proved to be more cooperative in following the instructions and guidelines for proper oral hygiene and dental care. All patients were nominated free from any previous prosthetic experience as this might distress utilizing a novel prosthesis ⁽⁴⁾.

Mandible was employed rather than maxilla in this study due to the prevalence of stresses on abutment teeth by a bilateral distal extension removable partial denture as; vertical, horizontal and oblique stresses which consequently converts the abutment to act as a fulcrum ⁽³⁾.

One of the key standards for patients' assortment in the current contemplates was Class I Angle's classification. This has been attributed to incidence of patients exhibiting any abnormal jaw relationship, TMJ disorders or parafunctional habits, might lead to extensive harmful effect on partial denture supporting structure ⁽²⁻⁴⁾.

Abutment teeth were peri-apically radiographed to notice any carious lesions, assess pulp size, inspect length, size, shape, number and inclination of roots. Moreover, this played role in assessing abutment's supporting structure, investigating lamina dura's continuity, periodontal space's width, crown/root ratio and detecting of any periapical or periodontal lesions ⁽⁵⁾.

Partially edentulous Kennedy class I modification 1 cases with unilateral pier abutment who received lower distal extension removable partial denture were the only candidates for this consideration. Since in case of employing bilateral distal extension cases instead, then many functional forces will have been applied to the denture base thus creating an axis of rotation around the most distal abutment ⁽⁶⁾.

Group I received removable partial denture retained by gingival approaching RPI clasps on the abutments as it offers the push type of retention (trip action of clasp) which is more active than the pull type one provided by the occlusal approaching clasp. Pier abutments received double occlusal rests (mesial and distal) as no clasp was placed on this lonely standing tooth ⁽⁷⁾.

On the other side, Group II received telescopic removable partial denture since telescopic crown was designated to retain a removable partial denture together with restoring the masticatory function and sheltering both the abutment teeth and residual ridge ⁽⁸⁾.

Moreover, telescopic crowns had few merits as applying axial load on the tooth and full coverage of the abutment, this sequentially diminish the tilting forces with their harmful influence on the abutment supporting structures. Such axial forces excite loss of both periodontal tissue and alveolar bone, provide indirect splinting, influence ease of oral hygiene maintenance and slick ways of repair ^(8 & 9).

Wax pattern construction took place by utilizing milling wax, since it is firm enough to be easily milled using wax trimmers deprived of distortion or fracture ⁽⁹⁾.

The Digora computerized system was employed for radiographic assessment in this consideration for avoiding the demerits of the conventional radiographic methods. Furthermore, this system is considered a precise and reliable

system for evaluating bone density variations if compared to the other methods besides offering the benefit of instant image display and minor radiation dose ⁽¹⁰⁾.

The first follow-up took place post the adjustment period for attaining patients' comfort and acting as a baseline for comparison through the following periods ⁽¹¹⁾.

Residual tissues' conservation was the focal principle targeted by any prosthetic therapy, this necessitated keeping remaining oral tissues in a healthy status that accordingly extended their life time. The value of considering any prosthesis's impact on the supporting oral structure cannot be denied at all, so in this contemplate both clinical and radiographic estimation were carried out and revealed post denture insertion variations displayed as; changes in bone density and bone height through the follow-up period ^(12 & 13).

Throughout prosecution periods, bone height was inconsequentially declined round the abutments in Group I. This might be attributed to the favorable features of the RPI clasp as; superior flexibility, diminished load on both ridge and abutments besides the abated stress applied to the principal ones. Hence, declining bone loss within the vicinity of the natural abutments ⁽¹⁴⁾.

Moreover, for Group II patients insignificant decrease in bone height around the abutments was noted during follow-up periods, this could be ascribed to the fact that the telescopic design is more stable and loads transmitted more evenly and axially. Such properties were more efficient in both absorbing and declining the loads falling on the abutments ⁽¹⁵⁾.

When equating the mean bone height's results between both groups, statistical analysis revealed insignificant differences between the two groups. However, it was found that bone resorption in height was higher in Group I than Group II patients ⁽¹⁶⁾.

This reveals that RPI clasps by time transmitted undesirable forces to the supporting alveolar bone of the abutments compared to the telescopic crown ones that absorbed stress and transmitted it more favorably within the patient's physiologic tolerance.

CONCLUSION

Within limitations of this study, the following can be concluded:

Conventional and telescopic RPDs are biologically successful as retainers for partially edentulous patients; Telescopic RPD revealed to be superior to the conventional one regarding bone height measurement.

Acknowledgments

None

Conflict of Interest

There is no conflict of interest to be declared.

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