Retention Force Measurement of Telescopic Crowns with Different Clearance Fit

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Abstract: Purpose: It was the aim of this study to compare the effect of telescopic crowns exhibiting stress releasing effect in the form of clearance fit between crowns, and crowns that intimately contact each other. **Materials and Methods:** Fifteen maxillary telescopic retained removable partial dentures (TRPDs) were constructed following the same biomechanical principles, divided equally according to the telescopic crown design into three groups: occlusally relieved telescopic crowns, gingivally relieved crowns, and the third group with no relief between primary and secondary copings. The change in retentive efficiency for the three groups was assessed using forcemeter at the time of denture insertion, 3, 6, and 9 months after denture use. **Results:** The results of this study revealed a decrease in the retentive efficiency in all telescopic crown designs, and a statistical significant difference was observed between the different designs. **Conclusion:** Telescopic crowns are both clinically and biologically successful as retainers for removable partial dentures. The frictional retentive efficiency of telescopic crowns reduced over time. Telescopic crowns with no clearance space provides better retention and maintains their retentive efficiency for a longer period compared to telescopic crowns with built in clearance space.

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1.Introduction:

Prosthetic solutions without implants are still of interest for financial and gerodontological reasons. A conventional removable partial denture (RPD) is a viable treatment option in these cases. Functional denture stability, good retention, oral comfort and satisfactory aesthetics are important factors for a successful treatment with RPDs. In addition, oral hygiene should be easy to perform and the distribution of the functional loads should be optimized among the abutment teeth and the alveolar ridge. [1, 2]

Taking these requirements into consideration, a TRPD is an alternative treatment option to a conventional clasp retained RPD.

Many literatures describe a high degree of intraoral comfort and a good long-term viability provided by conical [1,3,14] and telescopic systems [1,4,16]. The problem of the principle of double crown retention is the frictional wear during the functional period, so thorough after care have a considerable impact on the long-term success of TRPDs. [5,14]

Three different types of double crown systems are used to retain RPDs. They are distinguished from each other by their differing retention mechanisms. Telescopic crowns achieve retention using friction of parallel-milled surfaces, and conical crowns exhibit friction only when completely seated using a “wedging effect,” whereas the double crown with clearance fit exhibits no friction or wedging during insertion or removal. Retention is achieved by using additional attachments.[6]

Conical crowns with clearance fit provide guidance, support, and stability against dislodging motion but less retention due to absence of friction or wedging during insertion or removal of the appliance. This clearance fit is precise, allowing a minimal, invisible lateral movement and a smooth, effortless gliding along the axis of the path of insertion. To achieve retention, the authors use the TC-SNAP system (Si-tec).[7]

To enable resilient support, the RPD is fabricated with an occlusal space of 0.3 to 0.5 mm between the inner and outer crowns. If occlusal load is applied, the denture moves in an occluso-apical direction, depending on the resilience of the denture-supporting mucosa, and returns to its former position after the load is removed.[8]

Another design of conical telescopic retainers with clearance space between the two crowns in the gingival third with 0.003 to 0.01 inch space allowing clearance for rotation of the secondary crowns anchored to their denture. This design eliminated the frictional retention of the denture without impairing the splinting action.[8]

This study aims to evaluate the retentive efficiency of different designs of telescopic retainers regarding the clearance space, either occlusally, or gingivally, and the precise fit with no space between crowns.

2.Materials and Methods

Fifteen maxillary telescopic retained partial overdentures were constructed for male patients aged 40-50 years, selected from the outpatient clinic, Prosthdontic Department, Faculty of Dentistry, Ain Shams University. Patients were selected depending on the following criteria: maxillary arch requiring replacement of molars of both sides (class I Kennedy classification), the mandibular arch was completely dentulous or with few missing teeth that could be restored with fixed prosthesis, patients were systemically free, healthy oral mucosa and well developed ridges, normal jaw relationship, no TMJ disorders, non smokers, and no history of habitual bruxism or clenching.

Abutments were selected after clinical assessment and evaluation of study casts and radiographs. Only cases requiring simple filling without the need for endodontic treatment or crowning were included.

2.1.Abutment Preparation

Tooth structure was reduced both buccally and proximally and less for the palatal side, the crown was slightly tapered occlusally to achieve a uniform taper angle ranging between 6-12 degrees. Both over and under reduction were avoided. Adequate reduction of the cervical area of the buccal surface was carried out to permit adequate thickness of both metal crown and veneered facing, a subgingival shoulder finish line was prepared. Reduction of the occlusal surface in both height and contour was carried out to achieve crown height of about 5-6 mm above the gingival margin.

Occlusal rest seats were prepared bilaterally on the occlusal surfaces of the teeth adjacent to the abutments for placement of indirect retainers.

Secondary impression was made using regular body silicone impression material (Aquasil-Dentsply) and poured in die-stone (Fuji Rock). Copings were cast using standard technique, checked carefully for complete seating and cemented in place with Type I glass ionomer cement (Fuji I).

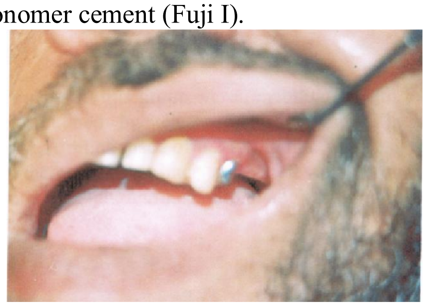

Figure (1): Intraoral view showing coping cemented to abutments

2.2.Denture Fabrication

A putty impression with the primary coping in place was made for the fabrication of the framework. Stone models were poured using stone die and the cast duplicated with Agar. The framework with secondary copings were waxed up on the refractory cast and cast in cobalt chromium alloy.

Figure (2): Metal framework try in seated in place

According to the design of the telescopic retainers the patients were divided into three groups:

Group I: Telescopic crowns with built in occlusal clearance. A relief space of 0.3-0.5 mm was designed occlusally between the primary coping and telescopic crown.

Group II: Telescopic crowns with built in cervical clearance. A relief space of 0.3-0.5 mm was designed cervically between the primary coping and telescopic crown.

Group III: Telescopic crowns with no relief between the primary coping and telescopic crown. Altered cast impression technique was made for all patients using individual acrylic resin tray attached to the metal framework, overdenture was fabricated following the steps of conventional partial overdenture.

2.3.Denture Insertion

The finished dentures were delivered to the patient, after verifying proper fit, extension and retention, selective grinding was carried out to establish stable simultaneous occlusal contact.

2.4.Post Insertion Protocol:

The patients were given the usual home care instructions for proper care of the prosthesis and oral tissues, post insertion records were made at the time of denture delivery, 3, 6, and 9 months after. The retentive force was measured by forcemeter that was held by metal rings placed in metal loops previously fixed at the geometric centre of the major connector and bilaterally palatal to the first molars. The results were collected, tabulated and statistically analyzed.

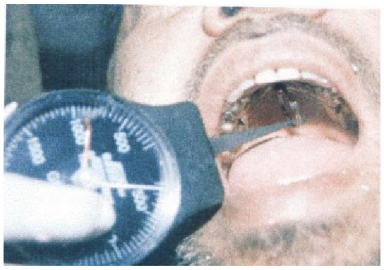

Figure (3): Intraoral view showing retentive force measurements

3.Results

3.1. Change in Retention of Dentures Retained by Occlusally Relieved Telescopic Retainers

The change in the mean difference of the values of the retentive force in grams of dentures retained by occlusally relieved telescopic retainers were found to be 12, 3, 10 and 25 grams three months after denture insertion, at the time interval between 3 to 6 months, from 6 to 9,and during the whole study respectively. These changes were statistically significant $p \leq 0.05$ except at the interval between 3 to 6 months where an insignificant change was evident.

Table (1):Mean differences, standard deviation and P- value for the change in retention of occlusally relieved telescopic retainers.

Observation periods	Mean difference	±S.D	*p* -Value	Significance
Delivery-3m	12	±4.5	0.004	*
3m-6m	3	±4.5	0.208	N.S.
6m-9m	10	±3.5	0.003	*
Delivery-9 m	25	±3.5	0.000	*

±S.D. Standard Deviation, N.S. Non Significant, m. month *Significant *P*:Probability level

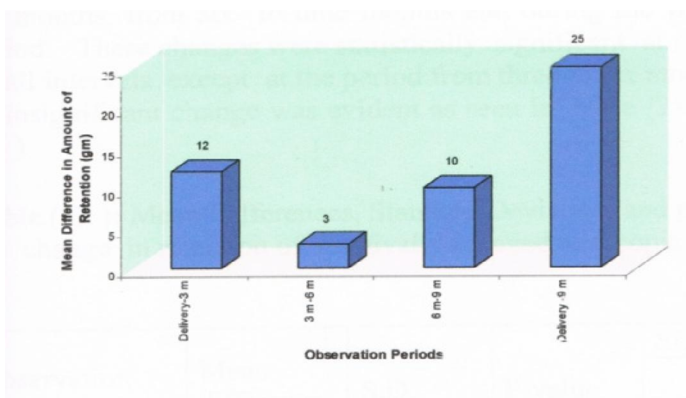

Figure (4): Mean differences of the change in retention of occlusally relieved TRPD

3.2. Change in Retention of Dentures Retained by Gingivally Relieved Telescopic Retainers

The change in the mean difference of the values of the retentive force in grams of dentures retained by gingivally relieved telescopic retainers were found to be 10, 2, 10 and 22 grams three months after denture insertion, at the time interval between 3 to 6 months, from 6 to 9, and during the whole study respectively. these changes were statistically significant $p \leq 0.05$ except at the interval between 3 to 6 months where an insignificant change was evident.

Table (2):Mean differences, standard deviation and P- value for the change in retention of gingivally relieved telescopic retainers.

Observation periods	Mean difference	±S.D	*P*-Value	Significance
Delivery-3m	10	±3.5	0.003	*
3m-6m	2	±2.7	0.178	N.S.
6m-9m	10	±2.2	0.001	*
Delivery-9 m	22	±2.7	0.000	*

±S.D. Standard Deviation, N.S. Non Significant, m. month *Significant *P*:Probability level

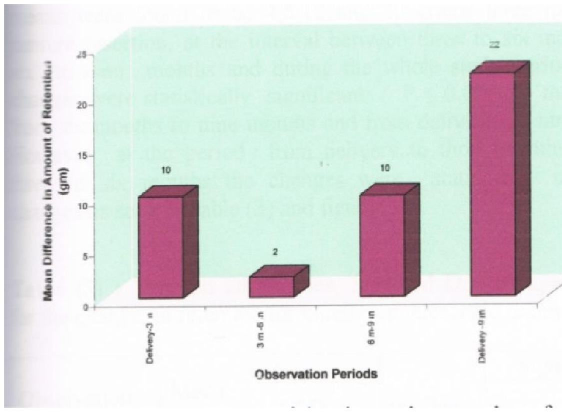

Figure (5): Mean differences of the change in retention of gingivally relieved TRPD

3.3. Change in Retention of Dentures Retained by Unrelieved Telescopic Retainers

The change in the mean difference of the values of the retentive force in grams of dentures retained by unrelieved telescopic retainers were found to be 4, 6, 10 and 20 grams three months after denture insertion, at the time interval between 3 to 6 months, from 6 to 9,and during the whole study respectively. these changes were statistically significant $p \leq 0.05$om at the intervals from 6 to 9 months, and from delivery to 9 months.

Table (3): Mean differences, standard deviation and P- value for the change in retention of unrelieved telescopic retainers.

Observation periods	Mean difference	±S.D	*P*-Value	Significance
Delivery-3m	4	±4.2	0.099	N.S.
3m-6m	6	±5.5	0.07	N.S.
6m-9m	10	±3.5	0.003	*
Delivery-9 m	20	±6.1	0.002	*

However at the period from delivery to 3 months, and 3-6 changes were statistically insignificant.
±S.D. Standard Deviation, N.S. Non Significant, m. month *Significant *P*:Probability level

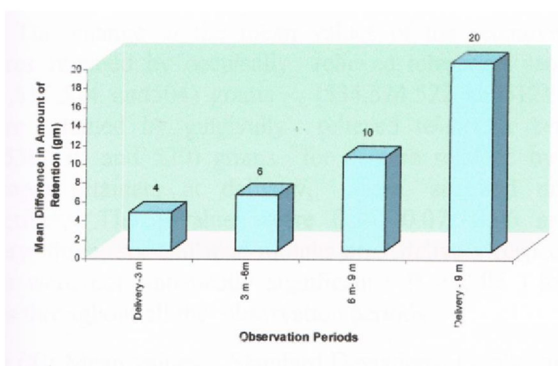

Figure (6): Mean differences of the change in retention of unrelieved TRPD

3.4. Effect of Different Telescopic Retainer Designs on Denture Retention

The change in the mean difference of the values of the retentive force in grams of dentures retained by occlusally relieved telescopic retainers were(529, 517, 514, and 504) grams, and (534, 524, 522, and 512) grams for dentures retained by gingivally relieved telescopic retainers, and (540, 536, 530, and 520) grams for dentures retained by unrelieved telescopic retainers at delivery, 3, 6, 9 months respectively. The *p* values were 0.34, 0.07, 006, and 006 at delivery, 3, 6, 9 months. The results were not statistically significant for three groups throughout the observation period.

Table (4): Mean values, standard deviation and P- value, and level of significance of the change in retention of different telescopic retainers throughout the follow up period.

Observation periods	Occlusally relieved retainers		Gingivally relieved retainers		Unrelieved retainers		*P*-Value	Significance
	Mean	±S.D.	Mean	±S.D.	Mean	±S.D.		
At Delivery	529	±11.9	534	±10.8	540	±11.2	0.34	N.S.
3m	517	±12	524	±11.9	536	±10.8	0.07	N.S.
6m	514	±9.6	522	±9.7	530	±7.1	0.06	N.S.
9 m	504	±8.9	512	±9.7	520	±7.9	0.06	N.S.

±S.D. Standard Deviation, N.S. Non Significant, m. month *Significant *P*:Probability level

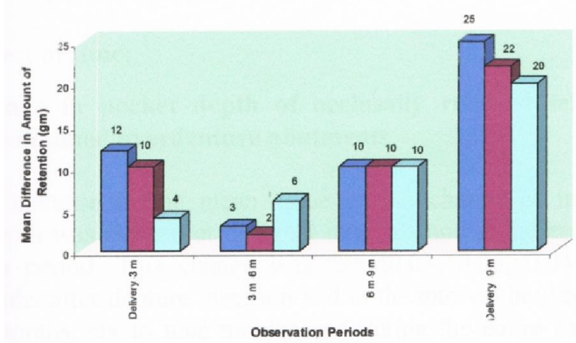

Figure (7): Mean values for the amount of for the different TRPDs.

4. Discussion

Attaining adequate retention in a removable appliance is a key factor contributing to the success of the prosthesis by pertaining proper function and patient comfort. However, excessive retention especially in distal extension bases (DEB) may result in loss of abutment teeth through the torque applied to them. For this reason, the amount of retention inducted to a DEB should be planned and controlled.[9]

This can be achieved by telescopic retainers which permit retention control by changing the taper angle and the height of the copings and by distributing the intimacy of contact between the telescope units as regard retention in DEBs, The double crown system retains dentures more effectively than do conventional clasp-retained RPDs and also shows more favorable transmission of occlusal loading to the axis of the abutment teeth.[10]

Dentures retained by conus crowns with gingivally placed clearance space exhibited slightly more retentive force compared to those retained by conus crowns with occlusal clearance as evident from the results. Probably, this is due to constant frictional resistance between the intimately contacting occlusal two thirds of the crowns elaborated when displacing forces were exerted followed by loss of frictional resistance due to the presence of occlusal relief.[4]

However, the results of this study revealed statistically insignificant difference neither the retention encountered by all of three designs nor in change in their retaining force during the follow up period which could be explained on the basis that the cone angle which was similar in the three designs is the major factor controlling the amount of retention delivered by telescope crown designs.[11]

This is similar to a study conducted by Wenz *et al.* who concluded that removable partial dentures retained by double crowns with clearance fit and constructed without major or minor connectors provide good clinical longevity. The survival rates of abutment teeth were comparable to those reported in the literature for other double crown systems. There was no significant increase of the risk of abutment loss when the restoration was placed on three or fewer remaining teeth and the concept of resilient support was applied.[12]

Reduction in the retentive force was noted in the three conus crown retained RPD designs these results was similar to the results of other clinical and *in vitro* studies that demonstrated reduction in the retentive force of telescopic crowns after several repeated insertions and separations. This change could be attributed to the decrease in conus friction force which may be due to wear of the metal used in the construction of crowns.[11]

The least change in the retentive force was detected in the conus telescope with no clearance exhibiting highest retentive values as evident in the results. Similar results were found by Ohakawa *et al.* who reported that the more retentive the telescope crown the less was the change in its retentive force. This could be attributed to a more steady path of insertion and removal. The change in retentive force of unrelieved conus telescope was slight and gradual during the follow up period and the greatest reduction occurred six month after insertion including the multiple insertion-removal performed by the patient. This would prove the role of metal wear in reducing the retentive force of conus telescopes.[13]

It was noted from the result of the study that the change in the retentive force was comparatively similar in both conus telescopes with clearance space. Statistically significant change in the retentive force of both designs was detected at an early stage in both groups which could be attributed to the lesser amount of retentive force delivered by these designs and their stress releasing effect permitting more denture movement.[6]

Conclusions

The following conclusions can be drawn from this study:

1. Telescopic crowns are both clinically and biologically successful as retainers for removable partial dentures.
2. The frictional retentive efficiency of telescopic crowns reduced over time.
3. Telescopic crowns with no clearance space provide better retention and maintains their retentive efficiency for a longer period compared to telescopic crowns with built in clearance space.

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