



Impact of TITACH Attachment on the Retention for Mandibular Implant Overdentures

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KEYWORDS

TITACH, Implant, overdenture,
Attachment, Retention

ABSTRACT

Aims: This clinical study aimed to evaluate the impact of TITACH attachment on the retention for mandibular implant overdenture. **Subjects and Methods:** Eight edentate's patients were eligible for this current work. All participants were received complete maxillary and mandibular dentures. Two dental implants were surgically inserted bilaterally in mandibular canine region. After 3 months of Osseo-integration, dental implants were exposed, healing abutments were screwed. According to techniques of TITACH incorporation to overdenture, patients were divided into two equal groups, Group I: 4 patients received mandibular implant overdenture that retained by direct incorporation of TITACH attachment. Group II: 4 patients received mandibular implant overdenture that retained by TITACH attachment with indirect incorporation technique. Retention was evaluated by digital force-meter. This evaluation was performed after 1 week of overdenture delivery (T0) and 6 months after overdenture delivery (6). The average retention was analyzed. The two groups were compared with independent t-test while paired groups were compared by paired t-test **Results:** Retentive forces of both incorporation techniques of TITACH attachment at different evaluation times revealed that, statistically significant difference in retentive forces at different evaluation times. On the other hand, there was statistically insignificant difference when group I and II were compared at different evaluation times. **Conclusion:** The TITACH attachment group showed favorable retentive force with 2 different incorporation techniques. The TITACH attachment could be a suitable choice when increased retention is required. However, the TITACH attachment showed high percentage change in retentive force but still accepted in both direct and indirect techniques.

INTRODUCTION

Edentulism is delineated as the complete loss of all natural teeth in the oral cavity and rendered to be the endpoint of multifactorial oral diseases and other comorbid conditions. It is considered the final marker of oral disease. It's apparently evident in elder people and was previously considered as a part of the normal aging process.⁽¹⁾

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Rehabilitation of edentulous patients with complete dentures has long been the prevailing standard of care. However, a long-term success of this therapy is unpredictable more often. Alveolar resorption associated with prolonged edentulism, particularly in the mandible, discomfort, reduced masticatory efficiency, speech difficulties, compromised retention, esthetics, and frequent denture fracture may compel such patients to seek for alternative therapy.⁽²⁾

An implant-retained overdenture is a removable prosthesis that is retained by implants and can be used to restore both complete and partial teeth loss.⁽³⁾ Since their introduction, they have been shown to be predictable, reliable, and highly successful for edentulous patients. Compared to conventional complete dentures, they provide patients with superior satisfaction, chewing capability, and oral health-related quality of life. They also increase retention and stability to higher levels.⁽⁴⁾

Since it was available for implant overdentures to be introduced, they have shown their high predictability and liability than conventional complete dentures, that used to be the first treatment modality for edentulous patients. They provide the patient with superior mastication capability, satisfaction, denture retention and stability and patients overall quality of life.⁽⁴⁾

Moreover, rehabilitation with implant supported overdentures significantly improves patient's facial profile due to the extension of flanges over the resorbed bone. Denture base gives support to upper and lower lips, cheek, mouth corners, marionette lines of the face, giving them some fullness restoring patient's previous profile, restoration of patient's phonetics and that greatly increases patient's satisfaction. There are different treatment options as complete arch fixed implant-supported prostheses, that do not need a labial flange, are significantly high expensive compared to conventional complete dentures or overdentures which need labial flanges.⁽⁵⁾

Two implant overdentures should be standard treatment option for edentulous patients, treated with overdentures. Now, two implant supported overdenture is minimum number of implants suggested for the completely edentulous patient. Thus, two-implant overdentures should be considered a possible alternative treatment for patients with edentulous mandibles.⁽⁶⁾

In general, Overdentures supported by two implants show more patient satisfaction than overdentures supported by more than two implants. Implant supported overdenture therapy had improved masticatory efficiency, bite force, thickness of masseter muscle, in addition to functional and psycho-social improvements.⁽⁷⁾

There are many types of attachment designs that can be classified into solitary attachment in addition to splinted attachments. two implants can be splinted when they relate to bar attachment and in this situation named as splinted attachments. On the other hand, the solitary attachments connect to each implant separately, the most widely attachment systems used are ball and socket, magnet, and locator attachments.⁽⁸⁾

A new attachment system named TITACH attachment. This new design allows metal-to-metal contact between cap and its abutment, dissimilar to the nylon attachment designs. The TITACH attachment composed of three parts: TITACH abutment, TITACH cap, and silicone sleeve. The metal cap has vertical slots to permit it to open on engaging its abutment. The silicone sleeve acts as a block-out part during the incorporation of the cap. After the pick-up procedure, sectioning of silicone sleeve is performed in half and placed between the cap and the housing as it locks under the outer edge of the cap.⁽⁹⁾

TITACH prosthetic system was developed as a solution for implant-assisted overdentures. It can be used for indications requiring up to 33° divergence for a single implant, or 66° divergence



between contralateral implants. It requires a vertical clearance of 4.5 mm and a diameter of 6 mm to accommodate the cap. It allows for up 0.2 mm of vertical cushioning, permitting compression of the mucosa during function and parafunction and gradual seating of the prosthesis. Moreover, each attachment can resist between 7-10 lbs. of force. ⁽⁹⁾

There are several techniques for attachment incorporation to the overdenture. These techniques can be classified into direct techniques which performed by the clinician and directly inside patient mouth and indirect techniques that occurred by the technician in the laboratory. ⁽¹⁰⁾

The choice between both incorporation techniques depends on, prosthetic design, implant position in relation to prosthesis, implant number and position, implants angulations, available prosthetic space, the need for processed denture bases, relations between maxilla and mandible, tissue changes after surgical implant placement, operator preference, availability of prosthetic components and finally the cost. ⁽¹¹⁾

The advantages of direct incorporation technique are simpler and easier, less expensive, less prosthetic elements and the patient allowed to retain the prosthesis. Unfortunately, this technique has disadvantages as it need more skill and accurate position of prostheses during curing time of the auto-polymerizing acrylic resin, avoid any resin flow into area of undercuts, in addition to, complications that associated to auto-polymerizing resin for example excessive shrinkage, porosities, rapid degradation and polishing difficulties. ⁽¹²⁾

The advantages of indirect incorporation technique are less time consuming, avoid any acrylic monomer contact, excellent denture polishing, allows the use of good mechanical properties of acrylic resin, patients who suffering from motor control diseases can be excellent treated using indirect technique. However, the impression taking to record implant position using implant transfer copings and

analogues may cause discrepancies that lead to attachment incorporation inaccuracy. ⁽¹³⁾

Retention is that quality inherent in the dental prosthesis acting to resist the forces of dislodgment along the path of placement.⁽¹⁴⁾ Retention of prostheses have been identified as the most important factors allowing more favorable implant overdenture treatment result and subsequently, improved satisfaction of edentate patient. ⁽¹⁵⁾

The accurate retention measurement need device combines the advantages of both in- vitro and in-vivo. As by using this new fabricated device allows standardization of the measuring methodology to get the most accurate readings by application of pure vertical force perpendicular to occlusal plane in presence of oral environment. ⁽¹⁶⁾

The null hypothesis was that no difference will be present among TITACH incorporation prosthetic system in two different studied groups on the retention for mandibular implant overdenture.

MATERIALS AND METHODS

Participant selection

Eight edentate's patients were eligible for this current work from the outpatients' clinic, Faculty of Dentistry ,Mansoura University, Egypt. The present work has been accepted by Ethics Committee (No: m 10071020), Faculty of Dentistry, Mansoura University. All participants informing about the detailed treatment plane and visits needed for follow-up, after that signed written consents were obtained.

The inclusion criteria dictated that; all participants were completely edentulous and had adequate residual alveolar bone quantity and quality at the region anterior to mental foramen and covered with healthy mucosa, the patients were of Angle's class I maxilla-mandibular relation with acceptable inter-arch space (verified by a tentative jaw relation). Complained from insufficient retention and stability of their conventional mandibular denture.

Exclusion criteria implied; the selected patients had no systemic disorders that hindering Osseo-integration process for example, diabetes being uncontrolled, or osteoporosis or hemophilia, history of chronic TMJ disorders or impaired neuromuscular control, head and neck radiation, Para functional habits like bruxism, heavy smoking, and alcoholism.

Pre-surgical procedures:

- All participants received new maxillary and mandibular complete dentures and were encouraged to wear them for 1 month to enhance muscle adaptation. CBCT was performed to evaluate bone height in mandibular anterior region. All patients were subjected to CBCT, and 2 dental implants were planned in the canine regions according to available bone width and length, position of fixation screws then construction of surgical guide was performed.
- Participants were administrated prophylactic antibiotic (500mg amoxicillin and 125 mg clavulanic acid) one day before and continue rinsing their mouth 7 days after surgery.

Surgical procedures:

After local anesthesia, patients were asked to bite on surgical guide using maxillary denture and fixation pins were placed in their positions, drilling bone with the first drill was done then guide was removed to assure drilling sites then placed again and successive drilling were done according to instructions supplied with surgical guide, surgical guide removed, and 2 dental implants (Implanova Dental implants, 13mm length×3.7mm diameter) were inserted bilaterally in mandibular canine region using standardized two-stage surgical protocol. Cover screws were then attached to the implants and the wound closure was performed. Corresponding to the implant position, the mandibular denture has been relieved and relined by applying a tissue conditioning material (Viscogel, Dentsply) then occlusion refining was performed.

Post-surgical procedures:

Participants were informed to apply ice packs in the first 24 hours. Also, they were informed to eat soft diet (e.g., fruit juices, soups, and soft pasta) and avoid hard foods (e.g., nuts and granola) which may become lodged in the surgical site. Participants were instructed for oral hygiene procedures and take the prescribed medication regularly.

Second surgical stage:

After 3 months of Osseo-integration period, a tissue punch was used to expose dental implants, then the healing abutments were placed for two weeks until the gingival tissue and gingival collar properly healed and formed Fig (1). After 2 weeks, healing abutments were removed.

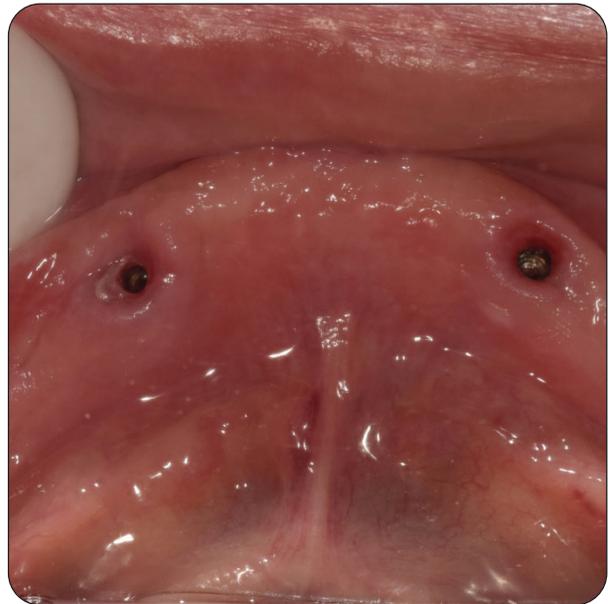


Fig. (1) Properly healed and formed gingival tissue and collar.

Patients grouping:

According to technique of TITACH attachment incorporation to overdenture, participants were divided into two equal groups as following:

Group I: include 4 patients who received mandibular implant overdenture that retained by TITACH attachment with direct incorporation by picking up the attachment housing intra-orally.

Group II: include 4 patients received mandibular implant overdenture that retained by TITACH attachment with indirect incorporation that performed in laboratory.

Prosthetics and incorporation (pick up) procedures:

For direct incorporation technique (Group I): firstly, two TITACH abutments were screwed to each implant using a torque wrench (Dental Evolutions Inc) to a torque of 20-Ncm Fig (2). After that, TITACH silicone sleeve Fig (3) was placed on the cap and its mandatory to sure that the silicone sleeve top was below the upper edge of the cap and not cover the retentive fins.



Fig. (2) TITACH abutment was screwed to each implant intraorally.



Fig. (3) The TITACH silicone sleeve.

The cap-sleeve assembly was placed firmly over the TITACH abutment until an accurate seated position was performed Fig (4). The sleeve must cover the entire neck of the abutment that extruding from the gingival area, this step is very important to prevent the acrylic resin from locking areas around the abutments. The overdenture was placed inside patient mouth, and the attachment position was identified by a marker.



Fig. (4) The cap-sleeve assembly was placed firmly over the TITACH abutment

Any marked contacts were relieved until the complete and accurate seating of overdenture was achieved. Two lingual vent windows in overdenture were done, this to permit escapement of the excess auto-polymerizing acrylic resin (Special Tray Material; Acrostone Co Ltd). The overdenture was seated to verify and ensure that there isn't any contact of the caps with the acrylic resin in any location.

Mixing of auto polymerizing resin was performed, it was placed in overdenture fitting surface. The overdenture was seated to incorporate the attachment caps. After setting of acrylic resin, the silicone sleeve was removed with the overdenture. Then the part of the sleeve protruding from the cap was sectioned in half by using a scalpel blade.

For the indirect incorporation technique (Group II):

Impression recording implant position was made using implant transfer copings and analogues. Appropriate TITACH abutments were selected and screwed into the implant analogs on the master cast in the laboratory and the prosthetic housings were placed on the TITACH abutments. The trial base assembly containing the prosthetic housings was adjusted to record the centric relation and vertical dimension of occlusion. The waxed denture with artificial teeth was verified intra-orally. The overdenture laboratory processing was finished. At the time of overdenture delivery, the TITACH abutments were screwed into the implants. The overdenture was seated over the TITACH abutments intra-orally and the fitting surface of overdenture was adjusted to achieve very intimate adaptation between overdenture and the residual ridge.

Assessment of retention:

Retention was measured using digital force-meter Fig (5 a). The digital force-meter was attached to apparatus⁽¹⁵⁾ that was used to make upward dislodgment of the mandibular overdenture by using u-shape hook that pull the denture in upward direction. Four L shape hooks were attached to the overdenture by self-cure acrylic resin at the canine and lower first molar areas at both sides.

The patient was asked to wear the denture and rest his chin to a horizontal plane. Then the u-shape fork of the device was inserted into patient mouth under the L shape hooks it should touch the four hooks at the same time for accurate readings Fig (5b). The wheel of force-meter was rotated this allow the device to move vertically until the overdenture was removed from its place. The force-meter reading was recorded.

The force was recorded in Newton & measured as retention. This process was repeated three times. The mean of which was then calculated. The data was collected and analyzed. Retention will

be evaluated by digital force-meter after 1 week from overdenture delivery (T0) and 6 months after mandibular overdenture delivery (T6).



Fig. (5) Digital force-meter device. b: patient wears mandibular overdenture and rest his chin for retention measurement.

Statistical analysis

Data were analyzed using the Statistical Package of Social Science (SPSS) program for Windows (Standard version 26). The normality of data was first tested with one-sample Kolmogorov-Smirnov test. Continuous variables were presented as mean \pm SD (standard deviation) for normally distributed data. The two groups were compared with independent t-test while paired groups were compared by paired t-test. The threshold of significance is fixed at 5% level. The results were considered significant when $p \leq 0.05$.

RESULTS

Table (1) and Fig. (6) revealed that retentive forces of direct incorporation of TITACH attachment at different evaluation times (T0 & T6). It showed statistically significant higher mean retention values ($P = 0.001^*$). For (group I), the mean was (77.84 ± 1.39 N) after 1 week after overdenture delivery (T0) while after 6 months of overdenture delivery (T6), the mean was (51.77 ± 4.74 N).



Table (2) and Fig. (6) revealed that the retentive forces of indirect incorporation of TITACH attachment at measurement times. It showed statistically significant higher mean retention values ($P \leq 0.001^*$). For (group II), the mean was ($76.57 \pm 1.05N$) after 1 week of overdenture insertion (T0) while after 6 months (T6), the mean was ($49.92 \pm 3.14 N$).

Table (3) and Fig. (7) showed comparison between direct TITACH incorporation (group I) and indirect one (group II) after 1 week of insertion (T0), it showed statistically insignificant mean retention

values ($P = 0.196$). For (group I), the mean was ($77.84 \pm 1.39 N$), For (group II), the mean was ($76.57 \pm 1.05N$).

Table (4) and Fig. (7) showed comparison between direct TITACH incorporation (group I) and indirect one (group II) after 6 months of insertion (T6), it showed statistically insignificant mean retention values ($P = 0.539$). For (group I), the mean was ($51.77 \pm 4.74 N$), For (group II), the mean was ($49.92 \pm 3.14N$).

Table (1) Retentive forces of direct incorporation of TITACH attachment at different evaluation times (T0 and T6).

	X	SD	Minimum	Maximum	Paired t test	P value
T0	77.84	1.39	76.91	79.87	15.08	0.001*
T6	51.77	4.74	47.71	57.85		

X: Mean, SD: standard deviation, *Indicates significant difference at 5% level. T0: 1 week after insertion. T6: 6 months after denture insertion.

Table (2) Retentive forces of indirect incorporation of TITACH attachment at different evaluation times (T0 and T6).

	X	SD	Minimum	Maximum	Paired t test	P value
T0	76.57	1.05	75.35	77.82	19.21	$\leq 0.001^*$
T6	49.92	3.14	46.92	54.18		

X: Mean, SD: standard deviation, *Indicates significant difference at 5% level. T0: 1 week after insertion. T6: 6 months after denture insertion.

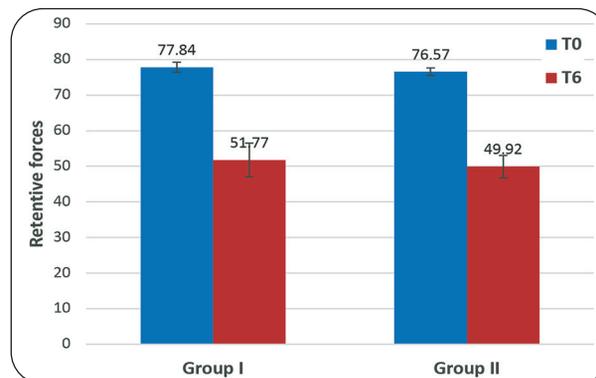


Fig. (6) Retentive forces of direct and indirect incorporation of TITACH attachment at different measurement times.

Table (3) Comparison between direct incorporation of TITACH attachment (group I) and indirect incorporation of TITACH attachment (group II) after 1 week of overdenture delivery (T0).

	X	SD	Minimum	Maximum	t test	P value
Group I	77.84	1.39	76.91	79.87	1.45	0.196
Group II	76.57	1.05	75.35	77.82		

X: Mean, SD: standard deviation, *Indicates significant difference at 5% level.

Table (4) Comparison between direct incorporation of TITACH attachment (group I) and indirect incorporation of TITACH attachment (group II) after 6 months after overdenture delivery (T6).

	X	SD	Minimum	Maximum	t test	P value
Group I	51.77	4.74	47.71	57.85	0.652	0.539
Group II	49.92	3.14	46.92	54.18		

X: Mean, SD: standard deviation, *Indicates significant difference at 5% level.

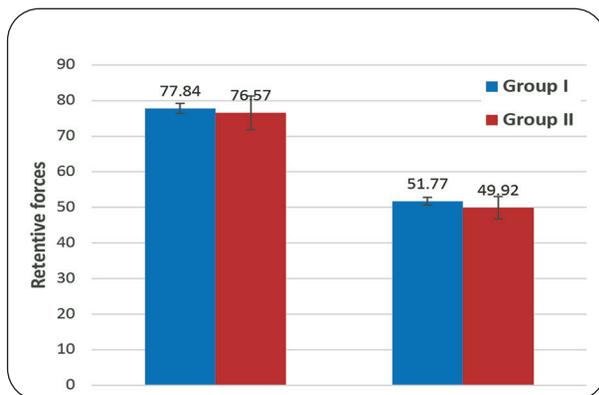


Fig. (7) Comparison between direct and indirect incorporation of TITACH attachment (group I and II) at different measurement times.

DISCUSSION

In this current work, mandibular implant overdentures were constructed on 2 implants in the inter-foraminal area. 2 dental implants were surgically inserted in the mandibular canine area as the first treatment option for completely edentate mandible is 2-implant overdenture.⁽¹⁷⁾ The retention was evaluated and compared in overdentures with TITACH attachment incorporation (direct & indirect methods), it was evaluated after 1 week of overdenture delivery to allow for complete settling

of the denture (T0)⁽¹⁸⁾ and after 6 months of overdenture delivery (T6).

The used device for measurement of intraoral retention forces overcomes drawbacks of the traditionally used methods. This new device provides pure vertical dislodging forces perpendicular to the occlusal plane and during the measurements, it eliminates and prevent tipping or rotation of overdentures. Moreover, it allows for standardization of points of load application.⁽¹⁶⁾

Attachment system selection for implant-retained overdentures depends on many factors including the number and distribution of dental implants, arch morphology, and patient expectations, inter-arch space, amount of retention required, and cost.⁽¹⁹⁾

Different attachment systems with varied prosthodontic designs (stud, bar, magnet, double crown) and materials (metal and polymer) are used as primary or secondary retention devices in removable mandibular overdenture, retained or stabilized on implants.⁽²⁰⁾ In the current study, in the present work, TITACH attachment was selected for evaluation as it is considered a new attachment



characterized by specific design of metal-to-metal interface between cap and abutment. ⁽²¹⁾

In the current study, the retentive forces of direct and indirect incorporation of TITACH attachment at different times of measurements. It showed statistically significant mean retention values at time of overdenture insertion. In this present study, TITACH was associated with higher retention forces. These results coincide with the findings of a previous in-vitro study ⁽⁹⁾ in which the authors found increased initial and final retentive forces of TITACH attachment as they compared it with locator attachment.

In this study, there was noted that, the retention values were decreased after 6 months of overdenture insertion. This reduction in retention was consistent with previous studies conducted on loss of attachment retention is the most common drawbacks of implant overdentures. ⁽¹⁹⁾

Doukas et al ⁽²²⁾ found that; there was significant decrease in retention, varying from 32% to 50% according to different inter-implant distance, in ball attachments with noble alloy matrix and titanium ball matrix, after 6 months of repeated manual removals.

Metal-to-metal contact between the TITACH attachment components which creates more friction and more retention forces. Although this metal-to-metal friction accelerates the wear of the attachment components and decreased retention occurred. ^(23,24) Also, wear of the metal attachment itself might contribute to the loss of retention over time. ⁽²⁵⁾

Ramadan and Mohamed ⁽²⁰⁾ who reported that TITACH attachments had higher final retentive force values after wear simulation. This could be attributed to the design of the TITACH attachments. The metal cap of the attachment had several metallic lamellae that engage the circumferential undercut of the TITACH abutments. The rigidity of these lamellae appears to maintain the retention forces even after wear and minimize the need of metal cap reactivation.

Also, the decreased retention values with time, this finding was in the agreement with Ellis et al; ⁽²⁶⁾ they reported that the most common maintenance requirement of any overdenture attachment, found to be the renewal or reactivation of the retentive element. Moreover, attachment systems exhibit wear during function, with subsequent decrease and even loss of retention.

In the current study, the comparison between direct and indirect incorporation of TITACH attachment (group I and II) after 1 week of insertion (T0) and after 6 months of overdenture insertion, it showed that, there was statistically insignificant findings between both groups (I&II). This observation agreed with the finding of Ahmed MHM who concluded that there were no significant changes in retention between both groups (direct and indirect) throughout the whole study period. ⁽²⁷⁾

Despite of there was statistically insignificant difference between both studied groups I &II (direct and indirect respectively), however, direct TITACH attachment incorporation revealed and resulted higher retentive values than that obtained from indirect TITACH incorporation. this finding agreed with previous studies that reported with direct technique as the posterior denture settling was greater in dentures fabricated with this direct technique than that with indirect one. ⁽¹⁸⁾ In addition, other finding reported that direct method was better when compared with indirect one, and this may be attributed to mucosal compressibility allowed more posterior denture settling during direct technique procedure as the biting forces of patient allowed and accentuated mucosal compression. ⁽⁸⁾

Overall, the null hypothesis was partially rejected in the current study.

CONCLUSION

Within the limitations of the current clinical study, the following conclusions were revealed:

1. The TITACH attachment group showed favorable retentive force with both incorporation techniques. The TITACH attachment could be a suitable choice when increased retention is required.
2. However, the TITACH attachment showed high percentage change in retentive force but still accepted in both direct and indirect techniques.

RECOMMENDATION

More long-term studies of variant evaluation methods are thus required to validate the results of this study.

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CONFLICT OF INTEREST

No conflicts of interest in connection with this article have been explicitly stated by the authors.

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تأثير رابطه التيتانش على ثبات قاعدة الاطقم المثبته على الغرسات السنيه

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الملخص:

الهدف: هدفت هذه الدراسة السريرية إلى تقييم تأثير مرفق التيتانش على الاحتفاظ بزراع الفك السفلي.

المواد والأساليب: كان ثمانية من مرضى عديمى الاسنان مؤهلين لهذا العمل الحالي. تم تلقي جميع المشاركين أطقم أسنان كاملة للفك العلوي والفك السفلي. تم إدخال اثنتين من غرسات الاسنان جراحياً بشكل ثنائي في منطقة كلاب الفك السفلي. بعد 3 أشهر من التكامل العظمي . تم الكشف عن غرسات الاسنان . وتم فك دعامات الشفاء. وفقاً لتقنيات دمج مرفق التيتانش مع الإفراط في تناول الطعام . تم تقسيم المرضى إلى مجموعتين متساويتين . المجموعة الأولى: تلقى 4 مرضى مغامرة زائدة في الفك السفلي تم الاحتفاظ بها عن طريق التضمين المباشر لمرفق التيتانش. المجموعة الثانية: تلقى 4 مرضى جراحة زائدة في الفك السفلي تم الاحتفاظ بها من خلال مرفق التيتانش بتقنية الدمج غير المباشر. تم تقييم الاستبقاء بواسطة مقياس القوة الرقمي. تم إجراء هذا التقييم بعد أسبوع واحد من التسليم الزائد (T0) و 6 أشهر بعد التسليم الزائد (6). تم تحليل متوسط الاستبقاء. تم مقارنة المجموعتين باختبار T المستقل بينما تمت مقارنة المجموعات المزدوجة باختبار T المزدوج.

النتائج: كشفت القوى الاحتياطية لكل من تقنيات التضمين لمرفق التيتانش في أوقات تقييم مختلفة . عن وجود فرق مهم إحصائياً في قوى الاحتفاظ في أوقات التقييم المختلفة. من ناحية أخرى. كان هناك فرق غير ذي دلالة إحصائية عند مقارنة المجموعة الأولى والثانية في أوقات تقييم مختلفة..

الخلاصة: أظهرت مجموعة مرفق التيتانش قوة احتباس مواتية باستخدام تقنيتي دمج مختلفتين. يمكن أن يكون مرفق التيتانش اختياراً مناسباً عند الحاجة إلى زيادة الاحتفاظ. ومع ذلك. أظهر مرفق التيتانش تغييراً بنسبة مئوية عالية في القوة الاحتياطية ولكنه لا يزال مقبولاً في كل من التقنيات المباشرة وغير المباشرة.

الكلمات المفتاحية: مرفق التيتانش . غرسة . طقم اسنان. ثبات. الالتصاق

