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Clinical and radiographic assessment of peri-implant tissue changes using two different implant connections with immediate implant placement and loading.

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ORIGINAL ARTICLE

Abstract

Aim: *Radiographic assessment of dimensional changes of peri implant tissues in immediately placed implants with non-functional loading in maxillary esthetic zone with Internal Hex (IH) and Conical Tapered (CT) connections*

Materials and Methods: *20 immediately placed implant with immediate loading were inserted in the maxillary esthetic zone, patients meeting the inclusion criteria were allocated into one of the two groups: Internal Hex or Conical tapered connection.*

Results: *Pink Esthetic Scores(PES) of the CT connection showed significantly higher values than IH. It was shown that the IH group showed statistically significant higher mean value than the CT connection in the values of crestal bone loss using CBCT.*

Conclusion: *CT connection has proved to result in better clinical, radiographic and volumetric outcomes than IH.*

Keywords: *Immediate implant, immediate loading, platform switching.*

Avaliação clínica e radiográfica de alterações do tecido peri-implantar usando duas conexões de implantes diferentes com colocação e carga imediata do implante.

Resumo

Objetivo: Avaliação radiográfica das alterações dimensionais dos tecidos peri-implantar em implantes imediatamente colocados com carga não funcional na zona estética da maxila com conexões Hex Interno (IH) e Cônico Cônico (CT)

Materiais e Métodos: 20 implantes imediatamente colocados com carga imediata foram inseridos na zona estética maxilar, os pacientes que atenderam aos critérios de inclusão foram alocados em um dos dois grupos: Hex Interno ou Conexão cônica cônica.

Resultados: O Pink Esthetic Score (PES) da conexão do TC apresentou valores significativamente maiores do que o IH. Foi demonstrado que o grupo IH apresentou valor médio estatisticamente significante maior do que a conexão CT nos valores de perda óssea crestal pela TCFC.

Conclusão: A conexão de TC provou resultar em melhores resultados clínicos, radiográficos e volumétricos do que IH.

Palavras-chave: Implante imediato, carga imediata, troca de plataforma

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INTRODUCTION

Dental implants have been widely recognized as one of the treatment options for the restoration of missing teeth (Faggion, Giannakopoulos, and Listl 2011). This treatment option is considered a complex one specially when replacing a maxillary anterior tooth, mainly owing to the set of events that follows tooth removal (Scala et al. 2014).

Changes in the alveolar ridge is a multifactorial physiological process which cannot be fully prevented, to some extent maybe owing to the blood supply loss from the periodontal ligament of the tooth after it's extraction (Araújo and Lindhe 2005).

A systematic review concluded that buccal and lingual soft tissue were proved to increase after tooth extraction which may mask the real degree of bone resorption and it's impact on the outcome of any procedure with special regards to the esthetic one (Tan et al. 2012).

Compared to the conventional method, where the socket is left to remodel before implant placement, immediate placement gives the opportunity of instant restoration, minimally invasive and more practical, as a result reducing the all in all treatment time and giving more patient satisfaction (Evans and Chen 2008; Sanz et al. 2010; S. Chen and Buser 2014).

The idea of switching platforms is to connect an implant of wide diameter to an abutment of narrower diameter, which is thought to preserve crestal bone (Lazzara and Porter 2006). This decrease in the abutment diameter creates a horizontal component that creates potential gingival augmentation in situ. This moves the microgap medially together with the inflammatory cellular infiltrate, so increasing the distance between inflammatory cells and the crestal bone (Cochran et al. 2013; Schwarz, Hegewald, and Becker 2014; Canullo, Caneva, and Tallarico 2017).

A study conducted by Morimoto et al. in 2015 mentioned that utilizing the immediate implant placement and provisionalization protocol could be advocated in the esthetic area when proper case selection is performed, as it helps in the maintenance of facial bone height and thickness regardless of the unavoidable minor vertical and horizontal bone alterations (Morimoto et al. 2015).

In 2014, a research by Carvalho examined the impact of various abutment materials as well as platform connections on stress distribution in restorations of single anterior implants using a finite element analysis (Carvalho et al. 2014). The maximum abutment stress prevailed in the Morse-tapered groups. Thus, the analysis concluded that the association of the platform connection had more influence on the stress on the abutments than on the abutment material.

MATERIALS AND METHODS

Implants used were:

Implants (JDental Care[1]). The internal hex JDIcon® and the conical connection JDIcon F.

Patient selection

- This was a randomized controlled clinical trial where 20 patients were selected from the outpatient clinic of the Oral Medicine, Periodontology, Diagnosis and Radiology Department at the Faculty of Dentistry, Ain Shams University. Study was reviewed and approved by the Faculty's research Ethics committee. The procedure was explained to all patients and an informed consent was signed before their inclusion in the study. Not more than two implants were placed in a single patient.
- Patients were allocated to one of the two groups randomly either IH or CT, having 10 patients in each group.
- Inclusion Criteria:

1. 20-40 years healthy male or female patient according to a health questionnaire by Modified Cornell Medical Index (Abramson 1966).
2. Non-restorable upper single maxillary tooth from 2nd premolar on one side to the other.
3. Absence of any periodontal disease.

Patient preparation and surgical procedure

- Cone Beam Computed Tomography (CBCT) was taken before the day of the surgery as baseline data.
- Atraumatic extraction of the tooth is performed without flap elevation (Fig.1).

Figure 1 occlusal view showing intact buccal wall (Left), extracted root (Right).

[1] JDentalCare s.r.l, Italy.

- Debridement of the extraction socket using bone curette[2] and then inspection of the socket with a periodontal probe[3] to check for any defects after extraction specially in the labial wall (dehiscence or fenestration).
- Implants were placed at 1mm apical to the buccal level of the bone crest.
- Bovine bone graft (cerabone[4]) was placed in the jumping distance between the implant and the buccal wall of the socket.
- Indirect impression was taken using addition silicon material for fabrication of the poly methyl methacrylate (PMMA) crown using impression coping and implant fixture.
- elivery of the temporary PMMA crown was done in 6 hours after surgery or maximum the day after (Fig.2).

Figure 2 Buccal and occlusal views after placement of temporary (PMMA) crown respectively.

- All contact on the provisional restoration was eliminated (Malchiodi et al. 2013).

Clinical evaluation

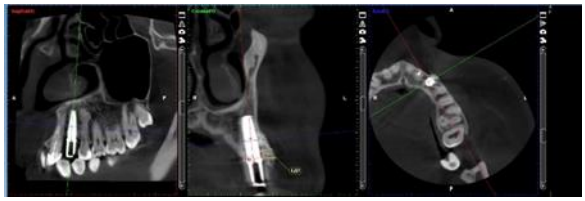
PES scores were taken on the day of temporary crown placement (T0) and 6 months after implant placement (T6).

Radiographic evaluation

CBCT scans were taken on the day of the surgery and 6 months later to be superimposed to allow for assessment (Fig.3).

[2] Helmut Zepf serrated curette, Germany.
[3] Hu-Friedy UNC 15 Co.,LLC-USA
[4] Cerabone granules 0.5-1mm by botiss biomaterials, Germany.

Figure 3 CBCT at baseline (immediate postoperative).



[4] Cerabone granules 0.5-1mm by botiss biomaterials, Germany.

After the superimposition, subtraction analysis done by the computer was performed to obtain the bone difference at 0 mm and 2 mm respectively (B0 and B2).

Statistical Analysis

Numerical data were presented as mean and standard deviation values and were explored for normality by checking the data distribution, calculating the mean and median values and using Kolmogorov-Smirnov and Shapiro-Wilk tests. The significance level was set at $p \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 26 for Windows.

RESULTS

1. Pink Esthetic score(PES):

A-Intergroup comparison:

- T0

Conical connection group (11.70±0.48) showed significantly higher mean value than Internal hex connection group (10.70±0.48) ($p<0.001$).

- T6

Conical connection group (12.20±0.63) showed significantly higher mean value than Internal hex connection group (11.10±0.32) ($p<0.001$).

B-Intragroup comparison:

- Conical connection group:

T6 (12.20±0.63) showed significantly higher mean value than T0 (11.70±0.48) ($p=0.025$).

- Internal hex connection group:

T6 (11.10±0.32) showed significantly higher mean value than T0 (10.70±0.48) ($p=0.046$).

2. Radiographic assessment:

A-Intergroup comparison:

® IBM Corporation, NY, USA.
®SPSS, Inc., an IBM Company.

- B0

Internal hex connection group (1.30±0.72) showed higher mean value than conical connection group (0.81±0.36) yet the difference was not significant (p=0.076).

- B2

Internal hex connection group (1.00±0.69) showed significantly higher mean value than conical connection group (0.34±0.20) (p=0.015).

- Overall

Internal hex connection group (1.15±0.70) showed significantly higher mean value than conical connection group (0.57±0.37) (p=0.003).

B-Intragroup comparison:

- Conical connection group:

B0 (0.81±0.36) showed significantly higher mean value than B2 (0.34±0.20) (p<0.001).

- Internal hex connection group:

B0 (1.30±0.72) showed significantly higher mean value than B2 (1.00±0.69) (p=0.002).

DISCUSSION

Dental implants have been a widely accepted treatment option showing high success and survival rates with high performance in function in various trials and retrospective studies (Ackermann et al. 2020). Over the last decades, a rapid evolution of techniques has been observed in modern dentistry. The protocols used for implant rehabilitation have been reevaluated over time, due to the increased patients' demands for comfort, aesthetic acceptance and shortened treatment time (Tettamanti et al. 2017).

Immediate implant placement right after tooth extraction helped in the reduction of the surgical procedures, reducing the treatment time in general and scaling down the complications as well (Pera et al. 2018).

Authors documented the highly beneficial role of the immediate provisional restorations in establishing a platform for early implant soft tissue healing (Saito et al. 2018).

There are many types of implant abutment connections, which show a micro gap that occurs at that connection between 1 to 49 µm. This gap is commonly located under the gingival soft tissue, very close to the surrounding bone, carrying a very important role in the contamination of the peri-implant tissues by causing microbial ingress as this micro gap increases in size (Carinci et al. 2016).

Different types of crown materials can be used in hybrid abutments for implant retained restorations. The longevity of these restorations and the amount of stresses falling on the implant body and the peri-implant tissues can be affected by combining the different

materials of choice with their corresponding implant abutment connection. This may either reduce or enhance the risk of crestal bone loss around the implant (Santiago Junior et al. 2013).

This study was a randomized controlled clinical study which investigated the clinical, radiographic, and volumetric analysis of dimensional changes of peri-implant tissue in immediately placed implants in fresh extraction sockets, with immediate non-functional loading in the maxillary esthetic zone, in implants with internal hex implant abutment connection, compared to conical taper implant abutment connection. The distribution between the groups was randomized.

JDental Care implants, were selected after thorough research of the available implant designs in the market, since both the internal hex and conical taper connection possessed the same external configuration in terms of the form, number and arrangement of threads that would influence the stress transmission from the implant to the surrounding peri-implant tissues (Bozkaya, Muftu, and Muftu 2004).

Age of the patients included in the study, started after complete growth (20 years), to halt the alveolar height growth effect that can be seen in younger patients. Moreover in the inclusion criteria, the presence of at least 3-5 mm bone apical to the tooth, to allow for implant engagement and primary stability.

Cone Beam Computed Tomography (CBCT) was used for diagnosis, treatment planning and later on in the assessment of ridge changes based on the results of a systematic review conducted in 2018, that suggest that CBCT offers cross-sectional images that show high precision and reliability for bone linear measurements of cross-sectional implant-related images that can be used for proper treatment planning (Fokas et al. 2018). Even though three scans were taken in one-year interval, the CBCT settings were set to be as low as reasonably achievable, to decrease the radiation dose levels of both second and third scans more than the first one.

In terms of survival rate, our study showed that immediate implant placement was a success of 100%, which is supported by a systematic review by Lang et al. (Tan et al. 2012).

The jumping gap that results between the implant and the bone after immediate implant placement was augmented with bone graft (Cerabone [5]), although there is evidence that this space will fill without adding any graft in small defects (S. T. Chen et al. 2005).

The results which were shown in our study, where clinical, radiographic and volumetric analysis of the peri-implant tissues were assessed. Comparing between the internal hex and conical tapered connections in immediately placed implants with immediate non-functional loading.

Our present in-vivo short term prospective study (6 months) displayed a high success rate of 100% of immediately placed implants with immediate loading in both

[5] Cerabone granules 0.5-1mm by botiss biomaterials, Germany.

groups (internal hex and conical) through the follow up period with no differentiation in success or survival rates.

Six months PES-outcomes demonstrated that both implant connections yielded noticeable improvement in the mean sum PES scores during the first 6 months following immediate implant placement and provisionalization. With statistically significant mean values for both groups conical and internal hex, with values 11.95 and 10.90 respectively.

These results agree with a study conducted in 2018, where it was a 3-year follow up study comparing between three implant configurations with immediate implant placement and provisionalization, proving that the dramatic improvement in the sum was in the first 6 months of the study (Barwacz et al. 2018). It also goes with agreement that soft tissue healing around implants are statistically significant in conical than internal hex implant abutment connection (Cheng et al. 2020).

When talking about the radiographic assessment done in our study, measuring the bone difference at two points B0 and B2, the internal hex connection group showed significantly higher mean value than the conical tapered group at both B2 and the overall bone difference. But, showed non statistically significant value when compared to the conical group at the level B0. This indicates greater crestal bone stability with the conical connection, as they are well known to greatly reduce the micro gap if not eliminate it between the implant and abutment, due to it's frictional fit, which results in stabilizing the peri-implant bone (Hajaj et al. 2018).

It is believed that the use of immediate implant placement together with immediate loading has also helped improve the results of our study.

CONCLUSION

Within the limitations of the study, it was concluded that:

Conical connection has proved to result in better clinical, radiographic, and volumetric outcomes.

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