



# Immediate Loading of Modified Acid Etched Dental Implants in Postextraction Sockets: A Histological and Histomorphometrical Comparative Study in Nonhuman Primate *Papio Ursinus*

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In the last 20 years, implant supported tooth replacement has totally changed the practice of dentistry, achieving high clinical success rate and predictability. The original Branemark's protocol<sup>1,2</sup> has been superseded by innovative operative protocols, such as postextraction implant placement,<sup>3,4</sup> early or immediate loading.<sup>5</sup> These novel approaches aimed to reduce the treatment time of conventional staged protocols and to preserve hard and soft peri-implant tissues.

After tooth extraction, the alveolar bone resorption may not only leave an aesthetic problem for the fabrication of conventional or implant supported prostheses but can also interfere or impede the correct placement of a dental implant.<sup>6</sup> Placement of an implant immediately after tooth extraction may help to maintain the bone crest and lead to an ideal implant position from a prosthetic point of view.<sup>7,8</sup> However, according to Araujo *et al*<sup>9</sup> the bone-to-implant contact established during the early phase of socket

**Purpose:** Immediate loading of dental implants inserted into fresh postextraction sites has recently been proposed as a novel but challenging surgical approach. However, histological evidence and comparative data are still missing. The aim of this study was an histological and histomorphometrical comparison of submerged and immediately loaded dental implants with a new modified acid etched surface inserted into postextraction sites of nonhuman primates.

**Materials and Method:** Thirty-two implants were placed in postextraction sockets of 4 adult *Chacma Baboons (papio ursinus)*. Each baboon received 8 implants: 4 submerged and 4 immediately loaded. The implants were retrieved after 90 days of healing with a 4-mm trephine

bur and processed for histology and histomorphometry.

**Results:** The bone-to-implant contact percentage in the submerged and immediate loaded implants was 86.02% and 86.85%, respectively, with no statistically significant differences. In the immediately loaded implants a greater amount of ongoing remodeling was observed.

**Conclusions:** Immediate loading seemed to be a valid alternative to conventional technique when a implant is inserted into postextraction sockets. Further comparative studies on a greater number of samples are necessary to confirm our findings. (*Implant Dent* 2009;18:142–150)

**Key Words:** acid-etched implants, bone-to-implant contact, immediate loading, postextraction sockets

healing after implant installation would be in part lost due to the continued resorption of the buccal bone wall. Thus, there is still debate on the tissue preservation capabilities of postextraction implants, but other advantages are undoubtedly demonstrated. These included a reduction of morbidity and treatment time, and better opportunities for a implant to osseointegrate due to the healing potential of the fresh extraction site.<sup>10</sup> Implants placed

into extraction sockets have been shown to be a predictable alternative to traditional treatment approaches.<sup>3,11</sup> In clinical practice, 2 treatment protocols have been used for postextraction implant placement: the submerged protocol<sup>12–14</sup> and the nonsubmerged protocol.<sup>15,16</sup> However, these protocols have been progressively challenged to decrease treatment time, minimize the number of surgical procedures, and maximize esthetic outcomes. Nowa-

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days, the challenge is to achieve a simultaneous extraction, implant placement, and loading. Regarding the possibility to combine postextraction implants and immediate loading, only few reports are available and they are based on limited series with short follow-up. Cooper *et al*<sup>17</sup> reported that the advantages related to this protocol include the maintenance of vertical dimension, elimination of reline procedures and interim denture therapy, and potential improvement of soft-tissue healing. They concluded that this therapeutic approach simplifies patient care without apparent additional risk. Vanden Bogaerde *et al*<sup>18</sup> developed a strict protocol to evaluate the feasibility of immediate/early function on implants placed in fresh extraction sockets. All patients were followed for 18 months, and none of the 50 implants failed. The authors concluded that the immediate placement of implants into fresh extraction sockets combined with immediate/early function procedures seems to be a safe and reliable procedure when using a strict protocol. Degidi *et al*<sup>19</sup> retrospectively evaluated 1074 immediately loaded implants, 416 of which in postextraction sites and 654 in healed sites and, after a 3-year follow-up, reported a 99.04% survival rate in the postextraction group, with only 4 implant failures. Finally, Chaushu *et al*<sup>20</sup> compared in a controlled, clinical trial 19 single-tooth postextraction and immediately loaded implants with 9 single-tooth implants inserted into healed sites. At a 6- to 24-month follow-up, the authors had a survival rate of 82.4% and 100%, respectively.

To our best knowledge, no comparative study between submerged and immediately loaded implants in postextraction sockets is available and more important, no histological reports show the outcome of postextraction implants under these loading conditions.

The aim of this study was an histological and histomorphometrical comparative evaluation of the bone response to submerged and immediately loaded implants with an acid etched surface in postextraction sockets of nonhuman primates.

## MATERIALS AND METHODS

### Implant Design and Surface Treatment

Thirty-two 3.75 × 3 mm implants (Leader Italia, Milano, Italy) were inserted in the hemimandibles of 4 adult nonhuman primates of the genus papio (*papio ursinus*). Each baboon received 8 implants: 4 implants were submerged and 4 implants immediately loaded. All implants had an acid etched surface modified as follows:

- Sonic bath in distilled water at a temperature of 25°C for 5 minutes to remove residuals deriving from manufacturing;
- Immersion in NaOH (20 g/L) + H<sub>2</sub>O<sub>2</sub> (20 g/L) at a temperature of 80°C for 30 minutes;
- Sonic bath in distilled water at a temperature of 25°C for 5 minutes;
- Acid etching in an organic mixture of 50% oxalic acid and 50% maleic acid at a temperature of 80°C for 45 minutes;
- Washing in distilled water and sonication for 5 minutes;
- Immersion for 30 minutes in a solution of 65% nitric acid and distilled water with a volumetric range of 1 to 1 at a temperature of 100°C;
- Washing in distilled water.

Surface morphology was analyzed by means of scanning electron microscopy (Stereoscan 360 Leica, Cambridge, UK). All samples investigated with SEM were sputter-coated with gold (Sputter Coater SC7640, Polaron, VG Microtech, East Grinstead, UK).

### Animal Model

Four healthy adult nonhuman primates of the genus papio (*papio ursinus*), with an average weight of 14.5 kg, were selected for the present study. The study protocol was approved by the Ethics Committee of the University of Witwatersrand, Johannesburg, South Africa and conducted according to the Guidelines for the Care and Use of Experimental Animals prepared by the University and in compliance with the National Code for Animal Use in Research, Education and Diagnosis in South Africa. The animals were sedated with an intramuscular injection of ketamine hydrochloride (Kiron lab-



**Fig. 1.** Postextraction implants inserted in the right hemimandible of baboons. Higher (7 mm) healing abutments were positioned and left in function.



**Fig. 2.** Postextraction implants inserted in the left hemimandible of baboons. Cover screw were positioned and mucosa sutured over the implants.

oratories Pty Limited, Benrose), 10 mg/kg body weight and anesthetized by infusion at a rate of 5 mg/kg body weight/h (Nembutal, Richter Pharm, Wales, Austria). The animals were maintained at 100% oxygen after orotracheal intubation. Under general anesthesia, a mucoperiosteal flap was elevated and mandibular molars and premolars were extracted to create edentulous ridges in the adult baboons. Immediately after extractions, 4 submerged (Fig. 1) and 4 immediately loaded implants (Fig. 2) were inserted in the left and right hemimandible of each animal (for a total of 32 implants), respectively. In the immediate loading protocol, implants were loaded with large cylindrical abutments and left unsplinted. All implants were inserted according to the manufacturer's instructions for human use.

### Histology and Histomorphometry

Ninety days after surgery, the animals were killed with an intravenous overdose of pentobarbitone sodium (Nembutal Abbott Laboratories, North Chicago, IL). Animals were subjected to bilateral carotid perfusion and specimens along with the surrounding alveolar bone and gingiva were harvested. Mandibles were completely removed and 2 bone blocks (right and left) were obtained using an oscillating saw. Each block, containing 4 dental implants, was further cut and fixed by immersion in 10% buffered formalin. The samples were then dehydrated in a graded series of ethanols, embedded in Technovit 7200 VLC resin (Kulzer, Wehrheim, Germany), and polymerized. The samples were then cut, using the EXAKT 310 Macro Band System with precision parallel control, ground to a thickness of 20  $\mu\text{m}$ , using P1200 grinding paper on the EXAKT 400 CS Micro Grinding (EXAKT, Nordenstedt, Germany), and finally polished using P4000 polishing paper. The sections were stained by a modification of the Goldner's trichrome method.<sup>21</sup>

The sections were then analyzed with a Provis AX70 research microscope (Olympus Optical, Tokyo, Japan). The digital images were captured using a computerized image analysis system (Flexible Image Processing System; CSIR, Pretoria, South Africa) connected to a capturing video camera (WV-CP410/G; Panasonic, Osaka, Japan). The percentage of bone-to-implant contact (BIC) was determined.

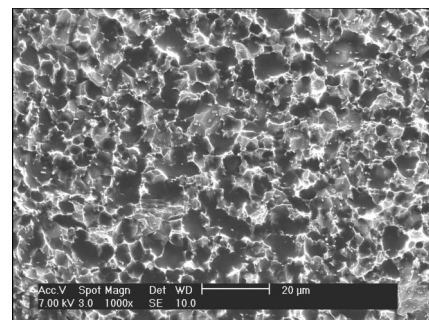
### Statistical Analysis

The BIC percentages values were expressed as means  $\pm$  standard deviation. The differences in the percentage of BIC between control and test implant were evaluated using unpaired *t* test.  $P \leq 0.05$  was considered significant.

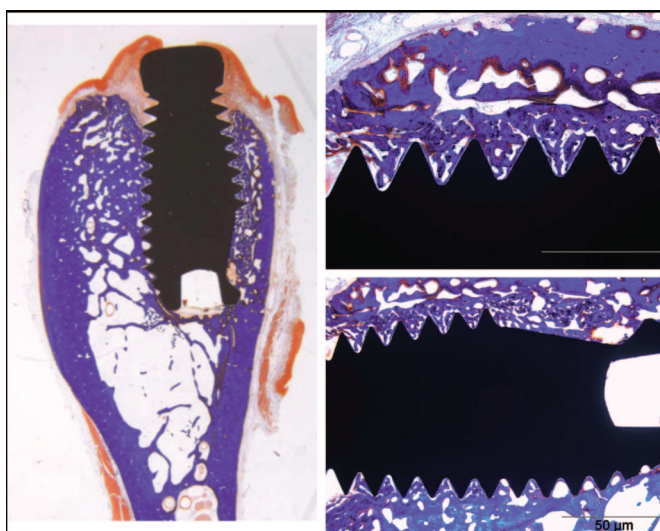
### RESULTS

Scanning electron microscopy revealed that the modified acid etched surface exhibited a micron-scale porosity with micro- and macroconcavities (Fig. 3). After 90 days, all implants were clinically stable, with no signs of inflammation. Histological

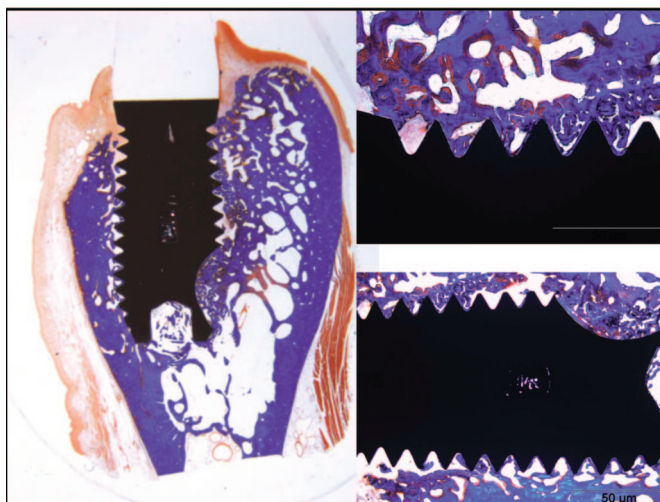
evaluation showed that all implants were osseointegrated. No acute or chronic inflammatory infiltrate was present. In both loading conditions bone regeneration apparently started from the residual alveolar bony housings and headed to the concavities between the implants threads, where more trabecular bone was observed. However, some differences were found. In the postextraction submerged implants bone tissue was observed at the level of the concavity between the second and third coronal



**Fig. 3.** SEM image of acid-etched modified implant surface.



**Fig. 4.** Submerged implant. It is possible to observe the formation of bone around the implant surface. A large portion of the implant perimeter is covered by bone. At higher magnification (inset), a close connection between bone and implant surface is present.



**Fig. 5.** Immediately loaded implant. A large part of the implant surface is covered by bone. At higher magnification (inset), bone is in tight connection with the implant surface.

threads, whereas in the postextraction immediately loaded implants bone tissue started from the first thread (Fig. 4). More important, in postextraction immediately loaded implants it was possible to observe few bone trabeculae heading coronally toward the implant collar and a greater amount of ongoing remodeling in the vicinity of the implant surface was found when compared with submerged ones (Fig. 5).

The mean BIC was  $86.03\% \pm 8.70\%$  in the submerged implants and  $86.85\% \pm 8.07\%$  in the immediately loaded implants, with no statistically significant differences.

## DISCUSSION

Many clinical and experimental study demonstrated the favorable outcome of dental implants immediately inserted into postextraction sockets,<sup>22,23</sup> also when bone chips were used to fill the remaining socket defect around the implant.<sup>24</sup> Postextraction implants can be placed in fresh sockets just after tooth extraction: these are called "immediate" implants. They can be inserted after weeks up to about a couple of months to allow for the soft-tissue healing: these are called "immediate-delayed." Finally, the term "delayed" implants is used for those implants placed in partially or completely healed bone.<sup>25</sup> In a recent review, Esposito *et al*<sup>25</sup> evaluated success, function, complications and patient satisfaction between immediate, immediate-delayed, and delayed implants and they concluded that immediate and immediate-delayed implants may offer some advantages over delayed implants in terms of patient satisfaction and aesthetics, possibly by preserving alveolar bone. After 1 year and a half follow-up no statistically significant differences between the examined groups were found with regard to prosthesis, implant failures, and complications. However, patients in the delayed group perceived the period between tooth extraction and insertion of the crown significantly longer than patients in the immediate-delayed group.<sup>25</sup>

To minimize the risk of implant failures, immediate postextraction implants were conventionally kept

load-free during the healing period. However, nowadays it is well known that immediate loading is a predictable procedure, which does not impair but rather enhances bone formation,<sup>26</sup> when some criteria are respected. In a review based on 11 randomized clinical trials including 300 patients in total, different times for loading dental implants were examined. The authors concluded that it was possible to successfully load dental implants immediately or early after their placement in selected patients, but a high degree of primary implant stability (high value of insertion torque) seems to be one of the prerequisites for a successful immediate/early loading procedure.<sup>27</sup>

Taking into account the increasing patient demand for time-saving procedures and the evidence-based success of immediate postextraction implants and immediate loading, the present study was designed to investigate the likelihood of combining the above mentioned procedures, providing histological evidences of osseointegration. Primary stability was achieved in both submerged and immediately loaded postextraction implants. There were no bone defects on the socket walls and a proper implant fit was obtained due to a sufficient amount of bone all around the extraction sockets, the drilling technique and the peculiar implant surface characteristics. In fact, it has been suggested that surface texture might dictate the mechanism of osseointegration, by influencing the stability of the fibrin scaffold, which is formed shortly after implantation.<sup>28,29</sup> A stable attachment of fibrin to the implant can be better achieved by a rough surface due to its greater surface area for protein adsorption. The acid-etched implants used in the present study showed a specific surface topography, consisting of micro- and macrocavities. Previously, a similar implant with an identical surface was histologically and histomorphometrically compared with machined, surfaced implants in human and nonhuman primates; after 60 days of healing acid-etched implants demonstrated a higher BIC when compared with controls ( $62\%$  vs  $45\%$ ) ( $25.55\%$  vs  $15.8\%$ ), in humans and primates, respectively.<sup>30</sup>

However, an evaluation of the role of implant surface topography is outside of the aim of this study and can be only acknowledged as a possible factor contributing to the success of the investigated therapy. Our histological and histomorphometrical findings strongly support the reliability of this technique, although whether or not the present results can be extended to humans deserve careful consideration. Actually, our histological data are only supported by a human histological case report where 2 implants (1 unloaded and 1 immediately loaded) were immediately inserted into fresh extraction sites. After 6 months BIC percentage was  $58 \pm 4.0$  and  $52 \pm 3.2$  in the unloaded and immediately loaded implants, respectively. The authors concluded that immediate loading did not seem to impair osseointegration of an immediate postextraction implant.<sup>31</sup> In the present study, the BIC percentage in the submerged and immediately loaded implants were almost the same ( $86.03\% \pm 8.70\%$  and  $86.85\% \pm 8.07\%$ , respectively), although in the immediately loaded implants a higher amount of ongoing remodeling seemed to be evident. This finding is in agreement with previous studies showing a higher degree of remodeling in immediately loaded implants when compared with unloaded implants.<sup>32</sup>

In conclusion, the present study demonstrates in nonhuman primates that immediate loading of postextraction implants might be a reliable and successful procedure, should primary stability be achieved and a rough surface used. Further comparative studies on a greater number of samples are necessary to confirm the present findings.

## Disclosure

The authors claim to have no financial interest, directly or indirectly, in any entity that is commercially related to the products mentioned in this article.

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## Abstract Translations

### GERMAN / DEUTSCH

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**Unmittelbare Belastung von bearbeiteten säuregeätzten Zahnimplantaten bei Einpflanzung in Postextraktionshöhlen: Eine histologische und histomorphometrische Komparativstudie an Tierprimaten der Bärenpavianart**

**ZUSAMMENFASSUNG: Zielsetzung:** Die unmittelbare Belastung von Zahnimplantaten, die in frische Bereiche nach erfolgter Zahnextraktion eingepflanzt wurden, wurde kürzlich als neuartiger chirurgischer Ansatz mit besonderen Anforderungen vorgestellt. Jedoch fehlen immer noch histologische Nachweise sowie Vergleichsdaten. Daher sieht diese Studie hier vor, einen histologischen und histomorphometrischen Vergleich versenkter und unmittelbar belasteter Zahnimplantate mit einer neuartig bearbeiteten Säuregeätzten Oberfläche, die in die durch Extraktion entstandenen Höhlenbereiche bei Tierprimaten eingesetzt wurden, durchzuführen. **Materialien und Methoden:** Thirty-two Implantate wurden in die durch Extraktion entstandenen Höhlen von 4 ausgewachsenen Bärenpavianen (papio ursinus) eingepflanzt. Jedem Pavian wurden insgesamt 8 Implantate eingesetzt: davon vier versenkte und vier unmittelbar belastete. Die Implantate wurden nach einer Heilungszeit von 90 Tagen mit einem 4-mm-Schädelbohrer entnommen und für die histologische sowie histomorphometrische Analyse weiter vorbereitet. **Ergebnisse:** Der Kontakt an der Knochen-Implantat-Schnittstelle betrug bei den versenkten Implantaten 86.02% und bei den unmittelbar belasteten 86.85%. Es ergaben sich keine statisch bedeutsamen Unterschiede. Bei den unmittelbar belasteten Implantaten wurde ein größeres Maß an fortdauernder Neugestaltung beobachtet. **Schlussfolgerungen:** Die unmittelbare Belastung eines Implantats scheint eine gangbare Alternative zu der konventionellen Vorgehensweise darzustellen, wenn es darum geht, das Implantat in die durch Zahnextraktion entstandenen Höhlen einzupflanzen. Weitere komparative Studien unter Einbeziehung einer größeren Anzahl von Proben sind zur Bestätigung unserer Ergebnisse erforderlich.

**SCHLÜSSELWÖRTER:** säuregeätzte implantate, knochenimplantat-kontakt, unmittelbare belastung, höhlen nach extraktion

### SPANISH / ESPAÑOL

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**Carga inmediato de implantes dentales modificados grabados con ácido en cavidades postextracción: un estudio comparativo histológico e histomorfométrico en primates papio ursinus no humanos**

**ABSTRACTO: Propósito:** La carga inmediata de implantes dentales colocados en cavidades frescas post extracción ha sido propuesta recientemente como un método quirúrgico novedoso pero problemático. Sin embargo, todavía faltan datos y evidencia histológica comparativa. El objetivo de este estudio fue realizar una comparación histológica e histomorfométrica de implantes dentales sumergidos y cargados inmediatamente con una nueva superficie modificada y grabada con ácido colocada en cavidades postextracción de primates no humanos. **Materiales y Métodos:** Se colocaron treinta y dos implantes en cavidades postextracción de 4 monos babuinos adultos Chacma (papio ursinus). Cada mono recibió 8 implantes: cuatro sumergidos y cuatro cargados inmediatamente. Los implantes se sacaron después de 90 días de curación con un trépano de 4 mm y procesados para su análisis histológico e histomorfométrico. **Resultados:** El contacto entre el hueso y el implante en los implantes sumergidos y cargados inmediatamente fue de un 86.02% y un 86.85%, respectivamente, sin diferencias estadísticas significativas. En los implantes cargados inmediatamente se observó una mayor cantidad de remodelamiento continuo. **Conclusiones:** La carga inmediata parece ser una alternativa válida a la técnica convencional cuando un implante se colocó en una cavidad postextracción. Estudios comparativos adicionales en un número mayor de muestras son necesarios para confirmar nuestros resultados.

**PALABRAS CLAVES:** implantes grabados con ácido, contacto entre el hueso y el implante, carga inmediata, cavidades postextracción

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**Carga imediata de implantes dentários modificados atacados por ácido em alvéolos pós-extração: um estudo comparativo histológico e histomorfométrico em papio ursinus primatas não-humanos**

**RESUMO: Objetivo:** A carga imediata de implantes dentários inseridos em locais de pós-extração recente foi proposta recentemente como abordagem cirúrgica original mas desafiadora. Contudo, evidência histológica e dados comparativos ainda estão faltando. O objetivo deste estudo era uma comparação histológica e histomorfométrica de implantes dentários submergidos e imediatamente carregados com uma nova superfície modificada atacada por ácido inserida em locais de pós-extração de primatas não-humanos. **Materiais e Métodos:** Trinta e dois implantes foram colocados em alvéolos de pós-extração de 4 Babuínos Chacma adultos (papio ursinus). Cada babuíno recebeu 8 implantes: quatro submergidos e quatro imediatamente carregados. Os implantes foram recuperados após 90 dias de cura com uma broca para trepanação de 4 mm e processados para histologia e histomorfometria. **Resultados:** A porcentagem de contato osso-implante nos implantes submergidos e de carga imediata foi de 86,02% e 86,85%, respectivamente, sem nenhuma diferença estatística significativa. Nos implantes imediatamente carregados foi observada uma quantidade maior de remodelagem em curso. **Conclusões:** A carga imediata pareceu ser uma alternativa válida à técnica convencional quando um implante é inserido em alvéolos de pós-extração. Estudos comparativos adicionais num número maior de amostras são necessários para confirmar nossas descobertas.

**PALAVRAS-CHAVE:** implantes atacados por ácido, contato osso-implante, carga imediata, alvéolos de pós-extração

## RUSSIAN / РУССКИЙ

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**Немедленное нагружение модифицированных протравленных кислотой зубных имплантатов в свежие лунки после удаления зубов: гистологическое и гистоморфометрическое сравнительное исследование на нечеловекообразных приматах Papio ursinus**

**РЕЗЮМЕ: Цель.** Немедленное нагружение зубных имплантатов, установленных в свежие лунки после удаления зубов, было недавно предложено как новый, но перспективный хирургический подход. Однако гистологические результаты и сравнительные данные все еще отсутствуют. Целью данного исследования стало гистологическое и

гистоморфометрическое сравнение заглубленных и немедленно нагруженных зубных имплантатов с новой модифицированной, протравленной кислотой поверхностью, установленных в свежие лунки после удаления зубов у нечеловекообразных приматов. **Материалы и методы.** Тридцать два имплантата были установлены в свежие лунки после удаления зубов у 4 взрослых медвежьих павианов (Papio ursinus). Каждому павиану было установлено 8 имплантатов: четыре заглубленных и четыре немедленно нагруженных. Имплантаты были извлечены через 90 дней заживления с помощью четырехмиллиметрового трепанационного сверла и подвергнуты гистологическому и гистоморфометрическому анализу. **Результаты.** Наличие контакта «кость-имплантат» у заглубленных и немедленно нагруженных имплантатов составило соответственно 86,02% и 86,85%, что не является статистически значимой разницей. У немедленно нагруженных имплантатов наблюдалось продолжающееся ремоделирование ткани. **Выводы.** Немедленное нагружение представляется эффективной альтернативой обычной методике, когда имплантат устанавливается в лунку после удаления зуба. Чтобы подтвердить наши результаты, требуются дальнейшие исследования с большим числом образцов.

**КЛЮЧЕВЫЕ СЛОВА:** протравленные кислотой имплантаты, контакт «кость-имплантат», немедленное нагружение, лунки после удаления зуба

## TURKISH / TÜRKÇE

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**Diş çekimi sonrasında diş yuvalarına modifiye asitle pürüzlendirilmiş dental implantların hemen yüklenmesi: papio ursinus primatlarında bir histolojik ve histomorfometrik karşılaştırmalı çalışma**

**ÖZET: Amaç:** Diş çekimi sonrasında taze yuvalara hemen dental implant yükleme, yakın geçmişte yeni fakat çetin bir cerrahi yaklaşımı olarak öne sürülmüştür. Ancak, halen histolojik kanıt ve karşılaştırmalı veriler mevcut değildir. Bu çalışmanın amacı, insan olmayan primatlarda yeni modifiye asitle pürüzlendirilmiş bir yüzeye sahip tam gömük ve hemen yüklenen dental implantların histolojik ve histomorfometrik bir karşılaştırmasını gerçekleştirmektir. **Gereç ve Yöntem:** 4 yetişkin Chacma şebeklerinde (papio ursinus) diş çekimi sonrasında diş yuvalarına 32 adet implant yerleştirildi. Her bir şebeğe, dört adet tam gömük ve dört adet hemen yükleme implantı olmak üzere 8 implant uygulandı. İmplantlar, 90

günlük iyileşme sürecinden sonra 4 mm'lik bir trephine testere ile çıkartılarak histoloji ve histomorfometre incelemelerine alındı. **Bulgular:** Tam gömük ve hemen yükleme implantlarının kemik ile implant temas yüzdesi sırasıyla %86.02 ve %86.85 idi ve aradaki fark istatistiksel açıdan anlamlı değildi. Hemen yüklenen implantlarda devam eden yeniden şekillenmenin (remodeling) daha yüksek düzeyde olduğu gözlemlendi. **Sonuçlar:** Diş çekimi sonrasında yuvaya implant yerleştirmede

hemen yüklemenin geleneksel tekniğe karşı geçerli bir alternatif oluşturduğu görüldü. Bulgularımızın teyit edilebilmesi için daha fazla sayıda örnekte karşılaştırmalı çalışma yapılması gerekmektedir.

**ANAHTAR KELİMELER:** asitle pürüzlendirilmiş implant, kemik-implant teması, hemen yükleme, diş çekimi sonrası yuva

## JAPANESE / 日本語

**抜歯窩へのmodified酸エッチング処理デンタルインプラント即時負荷: non-human primate チャクマヒヒにおける組織学ならびに組織形態測定学比較研究**

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### 研究概要:

**目的:** 抜歯直後部位へのデンタルインプラント埋入即時負荷は斬新でやりがいのある手術措置として目下提案されているが、組織的証拠や比較データが未だに欠けている。当研究はnonhuman—primateの抜歯窩に二回手術法 (submerged) と即時負荷で埋入した新modified 酸エッチング表面のデンタルインプラントを組織学と組織形態測定学の両面で比較することを目的とした。

**素材と方法:** 4頭の成熟チャクマヒヒ (Papio Ursinus) の抜歯窩に32本のインプラントを埋入した。それぞれのヒヒに8本のインプラントを次の方法で埋入した: 4本をsubmerged、そして残り4本を即時負荷という内訳である。90日にわたる治療期間を経て4mmのトレフィンバーでインプラントを回収し、組織学と組織形態測定学上調査目的で処理した。

**結果:** submerged と即時負荷における骨とインプラントの接触率はそれぞれ86.02% に対し86.85%で、統計上際立った差異は見られなかった。また即時負荷インプラントには継続した変化が比較的多く確認された。

**結論:** 即時負荷は抜歯窩にインプラントを埋入する場合に、従来技術の代替手段として妥当性を示している。ただし今回の研究成果を確認するには、今後ともより多数のサンプルを対象にした比較研究を要する。

**キーワード:** 酸エッチングインプラント、骨インプラント接触、即時負荷、抜歯後ソケット

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## CHINESE / 中国語

**在拔牙後齒槽立即載入修正的酸蝕牙科植體: 靈長類豚尾狒狒的非人類組織學及組織形態學比較研究**

作者: Carlo Mangano, MD, DDS; Adriano Piattelli, MD, DDS; Francesco Mangano, DDS; Vittoria Perrotti, DDS, PhD; Giovanna Iezzi, DDS, PhD

### 摘要:

**目的:** 近期提出在剛拔牙後的部位插入立即載入式牙科植體的手術方法, 新奇且有挑戰性。然而, 至今仍無此方法的組織學證據及比較數據。本研究的目的是在非人類靈長類拔牙後部位插入沉入式和立即載入式酸蝕表面牙科植體, 以進行組織學及組織形態學比較。



**資料與方法:** 在 4 隻成人南非狒狒 (豚尾狒狒) 置入 32 顆植體, 每隻狒狒 8 顆: 4 顆沉入式和 4 顆立即載入式。治療 90 天後以 4 mm 骨鑽取出植體並做處理以進行組織學及組織形態學分析。

**結果:** 沉入式和立即載入式植體的骨植體接觸比例分別為 86.02% 和 86.85%, 沒有明顯的統計差異。在立即載入式植體觀察到較大量的持續重組。

**結論:** 在拔牙後齒槽窩插入植體時, 立即載入似乎是能有效替代傳統技術的選擇。有必要進行更大量樣本的比較研究以確認我們的發現。

**關鍵字:** 酸蝕植體、骨植體接觸、立即載入、拔牙後齒槽窩

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## KOREAN / 한국어

**발치 후 소켓에 조제 산으로 부식된 치과용 임플란트를 즉시 부하: 비인간 영장류 차크 마개코 원숭이(Papio Ursinus)에서 조직학 및 조직형태측정학적 비교 연구**

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### 요약:

**목적:** 금방 발치한 위치에 치과용 임플란트를 즉시 부하하는 방법은 최근 도전해볼 만한 외과 수술적 접근법으로 새롭게 제안되고 있다. 그러나, 조직학적 증거와 비교 데이터는 여전히 많지 않다. 본 연구의 목적은 비인간 영장류의 발치 후 위치에 삽입된, 새로 조제된 산으로 표면이 부식된 치과용 임플란트의 즉시 부하와 매몰의 조직학적, 조직형태측정학적 비교에 있었다.

**재료 및 방법:** 4마리의 어른 차크 마개코 원숭이(Papio Ursinus)를 발치 후 소켓에 32개의 임플란트를 식립하였다. 각 원숭이는 임플란트 8개를 식립 받았다. 4개는 매몰되고 4개는 즉시 부하되었다. 치유 90일 후 조직학, 조직형태측정학적 검사를 위해 4mm의 천공기로 임플란트를 검사하였다.

**결과:** 뼈- 임플란트 접촉 비율은 매몰과 즉시부하 임플란트에서 각각 86.02%와 86.85% 로 통계학적으로 유의한 차이가 없었다. 즉시 부하 임플란트에서 진행성 재형성과정이 더 많이 관찰되었다.

**결론:** 발치 후 소켓에 임플란트 삽입 시, 즉시 부하법은 기존 기술의 유용한 대체법으로 보인다. 이 같은 연구결과를 확증하기 위해서는 더 많은 모델을 대상으로 하여 많은 비교 연구들이 시행될 필요가 있다.

**키워드:** 산으로 부식된 임플란트, 뼈-임플란트 접촉, 즉시 부하, 발치 후 소켓

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