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TRABAJO DE FIN DE GRADO

Grado en Odontología

COMPLICACIONES BIOMECÁNICAS EN IMPLANTOLOGÍA: AFLOJAMIENTO Y FRACTURAS EN TORNILLOS E IMPLANTES.

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1. RESUMEN:

- Objetivos: en esta revisión bibliográfica se pretende conocer y analizar las dos complicaciones mas frecuentes que se producen en el tratamiento con implantes, siendo estas el aflojamiento y la fractura. Conociendo los distintos factores que favorecen la aparición de dichas complicaciones, evaluando la importancia de cada uno de ellos y destacando los más importantes. Finalmente veremos la incidencia de cada una de estas complicaciones.
- Materiales y métodos: durante el mes de octubre y el mes de noviembre de 2020, se realiza una minuciosa búsqueda bibliográfica en bases de datos digitales empleadas en el ámbito odontológico, y con la aplicación de criterios de inclusión y exclusión, se seleccionan y analizan 53 artículos de los 70 posibles, que posteriormente se compararon entre ellos, con el fin de resolver los objetivos propuestos.
- Discusión: tanto el aflojamiento como la fractura de los tornillo e implantes son complicaciones comúnmente analizadas y estudiadas ya que son de origen multifactorial y actuando sobre dichos factores podemos reducir la su probabilidad, es decir, desde el inicio del tratamiento se pueden ir sumando errores micrométricos que en su conjunto aumentan la incidencia de dichas complicaciones. Los factores mas destacados son, el diseño del implante (ancho, longitud o tipo de conexión), diseño protésico, localización y angulación del implante y el ajuste pasivo (100-150micras).
- Conclusión: se considera al aflojamiento como la complicación más frecuente (7-9%) mientras que la fractura es la más grave pero poco frecuente (0,6-1,5%) y que al ser el resultado de la suma de varios factores evitables debemos seguir

investigando sobre ellos, insistiendo en los estudios *In Vivo* sobre ajuste pasivo entre otros. Por lo tanto y con el fin de evitar dichas complicaciones, la planificación del tratamiento debe englobar tanto los aspectos relacionados con los implantes como aquellos relacionados con la rehabilitación protésica.

2. ABSTRACT:

- Objectives: this bibliographic review aims to know and analyze the two most frequent complications that occur in implant treatment, these being loosening and fracture. Knowing the different factors that favor the appearance of these complications, evaluating the importance of each of them and highlighting the most important ones. Finally, we will see the incidence of each of these complications.
- Materials and methods: during the month of October and the month of November 2020, a meticulous bibliographic search is carried out in digital databases used in the dental field, and with the application of inclusion and exclusion criteria, they are selected and analyzed 53 articles out of 70 possible, which were later compared between them, in order to solve the proposed objectives.
- Discussion: both the loosening and the fracture of screws and implants are complications commonly analyzed and studied since they are of multifactorial origin and by acting on these factors, we can reduce their probability, that is, from the beginning of treatment errors can be added micrometers that together increase the incidence of these complications. The most prominent factors are

the design of the implant (width, length or type of connection), prosthetic design, location and angulation of the implant and passive fit (100-150 microns).

- Conclusion: loosening is considered the most frequent complication (7-9%) while fracture is the most serious but infrequent (0.6-1.5%) and, as it is the result of the sum of several Avoidable factors, we must continue investigating about them, insisting on In Vivo studies on passive adjustment among others. Therefore, and in order to avoid such complications, treatment planning must encompass both aspects related to implants and those related to prosthetic rehabilitation.

3. ÍNDICE:

4. INTRODUCCIÓN:

Los implantes dentales son dispositivos en contacto íntimo con el hueso maxilar o mandibular, cuya función es recuperar la función y forma perdida por el edentulismo. Dichos implantes deben tener una serie de requisitos que nombraremos a continuación(1).

1. Biocompatibilidad: es la capacidad de los materiales para actuar localmente, sin provocar ninguna reacción adversa, además de guiar la cicatrización normal de heridas, la reconstrucción y la integración de tejidos (2). Hoy día el material que mejor cumple esta característica es la aleación de titanio Ti6Al4V(1).
2. Biotolerabilidad: capacidad que tienen los materiales de permanecer durante periodos largos de tiempo, dentro del organismo, produciendo una mínima reacción inflamatoria (2).
3. Osteointegración: definido por primera vez en 1952 por Branemark como "la conexión directa, estructural y funcional entre el hueso y la superficie del implante sometido a carga funcional", esto es considerado, a día de hoy, el requisito mas importante, considerando que un implante está osteointegrado al no existir ningún movimiento entre el implante y el hueso (1). Esto lleva al siguiente concepto.
4. Estabilidad primaria del implante: resistencia y rigidez de la unión entre hueso e implante, antes de producirse la osteointegración y que va a depender del diseño del implante, el procedimiento quirúrgico y de la

densidad y dureza ósea, evitando los micromovimientos iniciales, mejorando la cicatrización y consiguiendo una mejor estabilidad secundaria que es la suma entre estabilidad primaria y estabilidad por aposición ósea durante la cicatrización. Además, está relacionada con el torque de inserción (3), es decir mediante fricción, pero hay que tener en cuenta que en las primeras semanas dicha estabilidad disminuye, por la necrosis producida al comprimir el hueso circundante y a la remodelación ósea posterior(4).

5. Superficie del implante: es otro requisito fundamental para la correcta adhesión y diferenciación de los osteoblastos tanto en la fase inicial de la osteointegración como en la siguiente remodelación ósea producida a largo plazo(4). Dicha superficie se puede clasificar en:
   a. Macrosuperficie: hace referencia a la geometría visible del implante como son sus espiras o su diseño cónico(4).
   b. Microsuperficie: son las rugosidades o poros producidos mediante los procesos de mecanizado, grabado ácido, anodización, pulido con chorro de arena, granalla o diferentes procesos de recubrimiento. Esto va a producir, además de un incremento de la superficie, una alteración en el crecimiento, metabolismo y migración de las células osteogénicas, produciendo también un aumento de citoquinas y factores de crecimiento de dichas células(4).
   c. Nanosuperficie: gracias a la nanotecnología, que modifica la nanosuperficie de los implantes, se cree que se producen cambios a

nivel físico, químico y biológico interactuando a nivel celular y proteico(4).

Otro concepto importante es el de biomecánica, que como definición general es el estudio de la estructura, función y movimientos de los sistemas biológicos, realizados tanto a nivel celular como en todo el organismo(5).

Cuando se habla de biomecánica en implantología oral nos referimos a las cargas directas recibidas sobre los implantes o bien de manera indirecta por medio de la restauración protésica durante la masticación. Además, hay que tener presente la tensión transmitida desde el implante hasta el hueso que lo rodea y su respuesta de adaptación.

Los factores que influyen en la biomecánica son los siguientes:

1. Diseño del implante (4,6):

a. Mecánico: existen múltiples diseños del cuerpo del implante, pero el más común es el que tiene forma de raíz cilíndrica o cónica dental donde, el pilar protésico puede ser independiente a dicho cuerpo, o estar unido a el en una solo pieza. Otro factor importante es la incorporación de espiras en la superficie del cuerpo del implante, que aporta hasta un 30% más de área de contacto que un implante cónico liso. Esta área es directamente proporcional al número de espiras y a su profundidad, es decir, cuantas más espiras y más profundas sean, mayor superficie de contacto y por lo tanto, mayor retención. Además, para evitar la rotación del implante, la parte apical debe ser plana y no puntiaguda, de esta forma, cuando el hueso crece no presenta cargas rotacionales.

b. Diámetro del implante: podemos encontrar implantes con diferentes tamaños que suelen oscilar entre los 2,5 y los 8mm, dependiendo del tipo de implante y de la casa comercial. Una mayor anchura supone un aumento del área de contacto entre el 30 y el 200%, influido por el diseño del implante. Además, los implantes anchos generan un mejor perfil de emergencia coronal.
c. Longitud del implante: al igual que el diámetro, la longitud de los implantes también es variable y suelen estar entre los 5-18mm, según el tipo de implante y casa comercial. Es importante tener en cuenta los factores de fuerza y la densidad ósea, es decir, cuanto mas blando sea el hueso más largo y ancho debe ser el implante.
d. Conexiones: existen dos tipos de conexiones, una externa donde la forma geométrica más común es el hexágono y esta sobresale de la plataforma. El otro tipo de conexión es la que se introduce dentro del cuerpo del implante, por lo tanto, se encuentra intraósea, presentando una mayor variedad de formas geométrica como son, el hexágono, el octógono, cono Morse o conexión cónica.

2. Micromovimientos excesivos:

Son los mayores de 100um y se producen entre el implante y el hueso, estos micromovimientos, deberían estar ausentes en el momento de la inserción del implante para una correcta osteointegración, ya que si lo estuvieran se produciría una sustitución de la reparación ósea por formación de colágeno y tejido cicatricial que nos llevaría al fracaso del implante(7).

3. **Localización del implante:**

Es importante conocer la calidad y cantidad ósea que presentan los maxilares, ya que se ha demostrado que estos dos factores, son de gran importancia en el éxito de nuestro tratamiento. La zona de mayor densidad ósea se encuentra a nivel anterior de la mandíbula, se sigue la zona anterior maxilar, luego la posterior mandibular y la zona de menos densidad es la posteromaxilar(8).

4. **Diseño de la prótesis**(5,9–12)**:**
    a. Con respecto a la prótesis, hay que evitar los voladizos, ya que su presencia provocaría un aumento de las fuerzas sobre los implantes, pilares, prótesis y sobre la interfase de hueso y diente, aumentando el riesgo de fracaso del tratamiento. En ocasiones se puede emplear el diseño en voladizo, pero este debe ser de la menor longitud posible, además debemos compensar el aumento de fuerza provocado por el voladizo, con el resto de los factores como la parafunción, dinámica masticatoria, altura coronaria, etc.
    b. Asimismo, hay que evitar tres pónticos seguidos sobre todo en el sector posterior, donde provocarían un aumento de la flexión de los pilares y de los implantes, aumentando el riesgo de fractura, descementado y afectación del tornillo de los pilares. El diseño ideal de grandes zonas edéntulas contempla dos implantes terminales y

uno o varios implantes intermedios, limitando cada zona edéntula al tamaño de dos premolares, que son unos 13,5 a 16mm.

c. Sería ideal dividir la arcada en cinco segmentos, de incisivo lateral a incisivo lateral; los caninos como segmento independiente y premolares y molares de cada hemiarcada.
d. Número de implantes: en ocasiones, para una mejor distribución de fuerzas, no bastaría solo con los implantes clave y, es necesario la colocación de implantes adicionales con el objetivo, de conseguir el principio de no voladizo o evitar tres pónticos seguidos. Además, se debe tener en cuenta la cantidad y calidad ósea junto con la magnitud de las fuerzas, para determinar el número ideal de implantes.

5. Carga protésica:

Se refiere al momento en el que la restauración es sometida a las fuerzas masticatorias.

a. Inmediata: cuando se coloca la prótesis en la primera semana posterior a la colocación del implante y que, dependiendo de varios factores, dicha carga puede ser funcional o no funcional donde la prótesis quedaría en anoclusión(7,10,12,13)
b. Temprana: entre primera semana y los dos meses tras la fijación del implante(10) .
c. Diferida: tras dos meses de la inserción del implante (10).

6. Ajuste pasivo:

No existe una definición exacta de su significado, pero se puede decir que la prótesis es pasiva cuando, no genera ni tensiones ni cargas estáticas sobre el implante o sobre el hueso que lo rodea, siendo fundamental para el éxito de nuestro tratamiento. Hoy día se considera aceptable un rango de 100-150 micras de discrepancia. Con dicho ajuste se consigue reducir la tensión a lo largo del implante y del hueso, para mantener la osteointegración, evitando posibles problemas clínicos a largo plazo y por tanto, aumentando la vida media del tratamiento(14).

La dificultad de conseguir un ajuste pasivo se encuentra en la complejidad y en los numerosos procedimientos, tanto clínicos como en el laboratorio, que se deben realizar para la confección de las restauraciones protésicas. En cada uno de estos pasos se producen errores mínimos y sería una combinación de varios de ellos, los que nos conducirán a la falta de dicho ajuste. A esto se le conoce como ecuación de distorsión y contempla los siguientes procedimientos(14–17):

a. Toma de impresión: su precisión depende de la estabilidad dimensional de la silicona de adicción o poliéter como material de impresión. También influye la técnica de impresión, ya sea digital, con cubeta abierta o cerrada, así como, el no ferulizar o ferulizar, junto al material empleado, de las cofias de impresión. Además, del número de implantes y su angulación.

b. Para la fabricación del modelo maestro, en muchas ocasiones, se usa escayola dental tipo IV, que presenta un 0,1% de expansión durante el fraguado.
c. Técnica de fabricación de la estructura protésica:
    i. Técnica de cera perdida, donde influye el 0,4% de contracción de cera al enfriarse, la expansión del material de revestimiento y la contracción del metal que puede oscilar entre el 1,42 y el 1,56%.
    ii. Técnica de fresado o mecanizado, que tras el diseño CAD, su precisión depende del tamaño de la fresa, es decir, las zonas mas pequeñas que la fresa serán sobrefresadas. Además, de su número de ejes, donde las de 5 ejes son más precisas que las de 4 ejes.
    iii. Técnica de sinterizado, es decir, ir añadiendo material cada a capa y que su principal inconveniente es la contracción durante la adicción del material, su endurecimiento o el grosor mínimo de capas.
d. Cocción de la porcelana: la distorsión se produce por la gran contracción de la porcelana durante este proceso y, sobre todo en la etapa de glaseado final.
e. Durante la entrega de la prótesis terminada: donde influye la capacidad del odontólogo para valorar el ajuste pasivo y que se puede ayudar de diferentes técnicas como la presión alterna con los dedos, observando el balanceo; visión directa y táctil con sonda de

exploración; radiografías; prueba de Sheffield o prueba del tornillo; prueba de resistencia de los tornillos y el empleo de pastas indicadoras de presión.

7. Fuerzas oclusales:

En la oclusión tenemos fuerzas axiales o verticales, que actúan perpendiculares al plano oclusal y que se dan en el sector posterior y las fuerzas oblicuas o laterales, como las que ocurren en el sector anterior.

En la rehabilitación con implantes, las fuerzas de mordida son similares a la dentición natural, tras los estudios realizados *in vivo*, hay variabilidad en los resultados y suelen ir desde los 20 a los 400N(7). Esta variabilidad va a depender del tipo de restauración realizada y su antagonista, es decir, si tenemos una prótesis fija completa sobre implantes en ambas arcadas, estamos perdiendo la propiocepción que aportan los dientes naturales, gracias a los mecanorreceptores periodontales y a consecuencia, se produce un aumento de fuerzas masticatorias(12,13).En los casos de PF parciales sobre dientes o dentición natural antagonista a nuestra rehabilitación con implantes, las fuerzas producidas son similares a la dentición natural(12,13,18). Las fuerzas laterales en implantología, según la posición y tipo de restauración pueden llegar a los 200 o 300, este tipo de fuerzas son peor toleradas por los implantes(5,19).

8. Parafunciones:

Son fuerzas perjudiciales que se producen sobre los dientes o los implantes, que ocurren sobre todo en el maxilar por su menor densidad ósea y el aumento del momento de la fuerza(12).

a. Bruxismo: rechinamiento horizontal y patológico de los dientes, conocido también como bruxismo excéntrico, produciendo un aumento de la carga masticatoria sobre la prótesis e implantes, además, de el resto de las estructuras del sistema estomatognático. Esta patología se suele dar durante el sueño, a diferencia del apretamiento como se verá mas adelante, teniendo como consecuencia un difícil diagnóstico, aunque gracias a los numerosos síntomas, como el dolor y aumento de volumen en los músculos masticatorios, abfracción cervical o fractura dental, descementado protésico y sobre todo el desgaste dental que también, nos ayuda a clasificar el bruxismo en ausente (sin desgaste incisal), suave (leve desgaste incisal sin compromiso estético), moderado (apreciable desgaste incisal sin desgaste oclusal posterior) y grave (ausencia de guía anterior y marcado desgaste posterior)(12).
b. Apretamiento: fuerza constante con ausencia de movimiento lateral o también llamado bruxismo céntrico o diurno, es más fácil de detectar por el propio paciente ya que, puede ser consciente de ello, pero mas complejo de diagnosticar por parte del odontólogo ya que, el desgaste oclusal es casi inapreciable. Hay que centrarse en la movilidad dental (fremitus), dolor e hipertrofia muscular, limitación de la apertura,

líneas de estrés en esmalte, abfracción cervical y cavidades limitadas a esmalte o material restaurador(12).

Se puede decir que ambos patrones presentan síntomas similares a diferencia, de un mayor desgaste oclusal en el paciente bruxista. Además se pueden emplear herramientas diagnósticas como el "Listado de Preguntas de Hábitos Orales", que es un cuestionario autoadministrado(12,20) (Anexo 1).

9. **Biológicos:**

Enfermedad periimplantaria, donde podemos diferenciar entre la mucositis periimplantaria, que es la inflamación reversible de los tejidos blandos que rodean al implante y, la periimplantitis es la inflamación y pérdida ósea alrededor del implante. Esta pérdida ósea, provocaría la exposición de las espiras del cuerpo del implante, estando en contacto con los cambios de temperatura y fluidos del medio oral, además de los alimentos, provocando el deterioro del material que, combinado con las cargas mecánicas repetidas, aumentaría la posibilidad de fractura o pérdida del implante(21,22).

Un mal diagnóstico y/o una incorrecta planificación del tratamiento puede dar lugar a la sobrecarga del tratamiento implantológico, es decir, se produciría un exceso de fuerza o estrés biomecánico que sobrepasa la capacidad funcional del implante, produciéndole fatiga y su posterior fractura que, es una de las complicaciones biomecánicas más frecuentes(1,23).

Por otro lado, dentro de las complicaciones más frecuentes, está el aflojamiento del tornillo, que es menos grave que la fractura. Dicho tornillo se aprieta sobre el implante, quedando fijado por fuerza de sujeción y, que al producirse una fuerza mayor que la de sujeción, daría lugar a su aflojamiento, produciendo movilidad, posibles alteraciones en los tejidos blandos o fractura del tornillo(1,23).

5. OBJETIVOS:

El objetivo de este trabajo es realizar una revisión bibliográfica sobre las posibles complicaciones biomecánicas producidas en prótesis sobre implantes.

Objetivo principal:

- Analizar la fractura de los tornillos y de los implantes, además de su aflojamiento.

Objetivos secundarios o específicos:

- Conocer los diferentes factores que intervienen en la fractura del implante y/o tornillo y su aflojamiento.
    - Diseño del implante.
    - Localización de los implantes.
    - Diseño de la prótesis.
    - Carga protésica.
    - Ajuste pasivo.
    - Micromovimientos.
    - Fuerzas oclusales.
    - Parafunciones.
- Conocer la incidencia de estas dos complicaciones analizadas.

6. METODOLOGÍA:

- **Diseño**: para conseguir los objetivos propuestos, se ha realizado una revisión bibliográfica de artículos de gran relevancia científica.
- **Estrategias de búsqueda**: la búsqueda se realizó en bases de datos digitales tales como, PubMed, Science Direct y Medline, de octubre a noviembre de 2020.

  Con el objetivo de ampliar el número de artículos, se analizó la bibliografía de los artículos encontrados y dicha bibliografía fue buscada en las bases de datos ya mencionadas.

  Además, se ha empleado el libro Contemporary Implantology del Dr. Carl E. Misch para realizar la introducción.

- **Palabras clave**: las palabras empleadas en los motores de búsqueda fueron dental implant, biomechanical complications implantology y fracture or loosening, con diferentes combinaciones entre ellas y que para hacer búsqueda mas detallada se utilizaron operadores booleanos como AND y OR.
- **Criterios de inclusión y exclusión:** una vez realizada la búsqueda bibliográfica de artículos relacionados con las complicaciones biomecánicas de los implantes, con el fin de seleccionar los artículos de mayor relevancia científica, empleamos la pirámide de la evidencia, seleccionando artículos basados en ensayos clínicos y revisiones sistemáticas, y por lo que los artículos donde el tipo de estudio fue realizado en animales o *In Vitro* fueron excluidos.

  Otro criterio importante ha sido la fecha de publicación de dichos artículos, la cual no debía ser inferior al año 2000. Además, los artículos debían estar a texto completo y preferentemente en inglés.

- **Extracción y análisis de datos**: tras la búsqueda inicial, se encontraron más de 70 artículos que podrían ser relevantes para la consecución de nuestros objetivos. La mayoría de estos artículos fueron leídos por completo y el resto solo se revisó el abstracts, con el fin de aplicar los criterios de inclusión y exclusión ya mencionados y por lo que, de los 70 artículos, se han seleccionado 53 de ellos.

7. DISCUSIÓN:

La complicación más frecuente pero menos grave es el aflojamiento del tornillo, como se ha comprobado en las revisiones sistemáticas realizada por S. Nithyapriya et al. (24) y Pjetursson et al.(25) o el meta-analisis realizado por Charles J Goodacre et al. (26).

En cuanto a la fractura del implante, es una complicación más grave que el aflojamiento, pero bastante menos frecuente como se ha observado a lo largo de los años, en distintas publicaciones como la de Gargallo-Albiol et al. (27), que muestra una incidencia del 1,4% en un total de 1.500 implantes o publicaciones más recientes como la de B. Sinjari et al. (28) en 2019 donde no se registraron fracturas en un total de 300 implantes tanto atornillados como cementados al igual que, en el estudio retrospectivo de 2020, realizado por Parzham et al. (29) en 1673 implantes que soporta tanto prótesis fijas parciales y completas, donde solo se observaron cuatro fracturas en un mismo paciente con prótesis parcial fija sobre implantes.

En referencia a la fractura de tornillo y teniendo en cuenta la literatura revisada, la incidencia se encuentra entorno al 4% como se demostró en la revisión bibliográfica realizada por Charles J. Goodacre et al.(26) donde se fracturaron 282 tornillo de un total de 7094 evaluados.

Para evitar la aparición de estas complicaciones, se debe actuar sobre los factores biomecánicos que influyen en ellas como, el diseño del implante (diámetro, longitud y conexión), localización del implante, diseño de la prótesis, ajuste pasivo y fuerzas oclusales.

Diámetro del implante:

En el estudio clínico, realizado en 2020, por Ki-Young Lee et al.(9), sobre el diseño del implante donde se analizaron un total 837 pacientes y 1928 implantes, con diámetros desde los 2,5 a 6 mm, se observó que implantes con diámetros superiores a 5mm presentan mayor incidencia (14,2%) de aflojamiento del tornillo, es decir, cuanto mayor sea el diámetro mayor será la posibilidad de aflojamiento, esto va en contra de otros estudios realizados, como el de Shin et al.(30) en 2014, que promulga que a mayor diámetro menor es la fuerza aplicada sobre el implante y por la tanto menor sería la incidencia de aflojamiento del tornillo, o el estudio realizado por Cho et al.(31) en 2004, donde los implantes que mayor aflojamiento sufrieron son los de menor diámetro. Estos estudios anteriores tienen como desventaja que no son estudios clínicos si no estudios *In Vitro*.

Si hablamos de fractura, en lo referente al diámetro del implante y según estudios clínicos como el realizado por C. Sánchez Acedo et al.(23), la mayor incidencia de ellas se producen en implantes con menor diámetro como los de 3,4mm frente a los de 3,75mm o mas, donde los primeros presentan una frecuencia de fractura de 2,10% de 233 implantes colocados y los segundos muestran un 0,77% de fractura de un total de 1617 implantes. Además, revisiones sistemáticas como la realizada por M.C. Goiato et al.(32) también demuestran que los implantes de menor diámetro, como los de 3,25mm, presenta una mayor incidencia de fractura. Esta mayor incidencia de fractura puede deberse a una menor superficie de osteointegración, por lo que factores como la magnitud de las fuerzas y la angulación de los implantes son factores clave que aumentan dicha incidencia, por lo que estos implantes deben usarse en ciertas localizaciones, como son la de los incisivos laterales superiores o incisivos inferiores que presentan una menor carga oclusal(32–34).

Tipo de conexión:

Según Ki-Young Lee et al.(9) los implantes de conexión externa fueron los que más aflojamiento del tornillo sufrieron, presentando una incidencia del 8,9%, frente al 5,4% de los implantes de conexión interna. Esto se debe a que la conexión externa permite pequeños movimientos de rotación coronal frente a los implantes de conexión interna que no permiten este tipo de movimientos junto, con una mejor distribución de las fuerzas laterales y una mayor superficie de contacto. Estas ventajas son mas evidentes si la conexión es interna y cónica como se afirma en articulo publicado por B.R. Merz et al(35). Yi, Yuseung et al(36), tras analizar 1289 implantes, llegaron a la misma conclusión, donde los implantes de conexión externa sufrían una mayor incidencia de aflojamiento frente los de conexión interna.

En relación a la fractura del implante, en esta revisión de la literatura y según el estudio realizado por Muley N. et al(37) y el realizado por Sailer I. et al(38) según el tipo de conexión y su relación con la fractura del implante se encuentra que, los que mayor incidencia de fractura presenta son los implantes de conexión externa, siendo el tornillo el componente mas afectado, ya que es el elemento más débil, a diferencia del implante y del pilar. Esto se debe, a que este tipo de implantes se diseñaron para recibir la mayor parte de las fuerzas producidas, donde las fuerzas laterales son las mas perjudiciales para este sistema, sobre todo en los casos donde se reemplaza un solo diente.

Por el contrario, los sistemas de implantes con conexión interna presentan una menor incidencia de fractura del tornillo ya que su diseño permite que las tensiones se distribuyan hacia el pilar y de ahí hacia el hueso, disminuyendo la posibilidad de fractura del tornillo.

La conexión de cono morse, dentro de las conexiones internas, aporta retención por fricción disminuyendo o eliminando los movimientos rotacionales implante-pilar y así reduciendo su posible fractura del tornillo.

Otros autores como Steinebrunner L. et al(39) y Maeda Y. et al(40) en sus respectivos estudios, demuestran que la conexión interna presenta menor resistencia a las cargas cíclicas, esto se debe a que este sistema de implantes presenta una pared interna más fina, que provoca una mayor deformación a nivel cervical y un mayor riesgo de fractura del implante además de producir una mayor reabsorción ósea marginal.

Por lo tanto, la correcta planificación del tratamiento implantológico, teniendo en cuenta que, si utilizamos implantes de conexión externa las tensiones van a recaer sobre el tornillo del implante aumentando la posibilidad de su fractura y en menor medida sobre el hueso, sin embargo, si usamos implantes de conexión interna el pilar y el hueso serán los que reciba las fuerzas más elevadas, disminuyendo la posibilidad de fractura del tornillo pero aumentando la posibilidad de fractura del implante.

Longitud del implante:

Según Ki-Young Lee et al.(9) en lo referente a la longitud se observó que no hay diferencias estadísticamente significativas, donde la mayor incidencia de aflojamiento se produjo en longitudes de 10-11,5mm (7,9%) y la menor incidencia fue para los implantes menores a 9,5mm (4,6%).

Cuando hablamos de fractura y según la literatura revisada, si realizamos una restauración protésica de mayor tamaño que el cuerpo del implante, las fuerzas oclusales van a producir un brazo de palanca y, por tanto, un aumento del estrés a nivel coronal del implante (5-7mm superiores) favoreciendo la reabsorción ósea y la mayor incidencia de fractura tanto del tornillo protésico como del propio implante o restauración(41).

Estudios mas recientes como los de Sun S et al(42) o el de Ghariani L et al(43) en 2015 y 2016, determinaron que a mayor longitud de la restauración mayor posibilidad de fractura del tornillo ya que es el elemento que mayor estrés recibe, además por cada milímetro que aumenta el tamaño de la restauración, se aumenta un 20% la tensión ejercida sobre esta zona(44).

Posición del implante:

Según Ki-Young Lee et al.(9), en cuanto a la posición del implante en la arcada, se observa una mayor incidencia de aflojamiento en la zona de molares (8,5%), seguida de la zona anterior (6,9%) y por última la zona de premolares (3,8%), al igual que se demostró en estudios anteriores. Si comparamos la incidencia entre el aflojamiento producido en el maxilar y en la mandíbula, es algo mayor en el maxilar, pero sin diferencias estadísticamente significativas.

Para Yi, Yuseung et al(36) en lo referente a la incidencia de fractura del tornillo del implante, la mayoría de ellas, se produce en la región anterior del maxilar (5,8%), esto de debe a que los implantes en el sector anterior sufren fuerzas laterales que favorecen su fractura si se supera el umbral máximo. Pero si hablamos de la fractura del pilar en prótesis cementada, todas se producen en el sector posterior, aunque sin diferencias estadísticamente significativas.

En la revisión sistemática realizada por M.C. Goiato et al.(32) al hablar de la posición del implante en cuanto a maxilar o mandibular, se observa una mayor incidencia de fractura para los implantes colocados en el maxilar (1,5%) frente a los situados en la mandíbula (0,8%), esto es debido a que el hueso mandibular es un hueso cortical, por lo que presenta una mayor estabilidad primaria y un menor fracaso, en comparación con el hueso trabecular del maxilar. Esto va en contra de lo expuesto en estudio clínico de Sánchez Acedo C. et al.(23), realizado en 2012 donde analizó 2765 implantes y la mayoría de las fracturas se producen en la región molar pero mandibular debido a las fuerzas oclusales.

Tipo de prótesis:

Ki-Young Lee et al.(9) afirma que las retenciones protésicas atornilladas son las que más aflojamiento presentan, confirmado en estudios más recientes como el de Parzham et al.(29), que afirma que el aflojamiento en prótesis cementadas es poco probable. En cuanto al tipo de prótesis que con mayor frecuencia presentan aflojamiento, por orden de mayor a menor, son las coronas individuales, puentes en voladizo, en especial los de mayor longitud, y las prótesis ferulizadas.

Esto ya se demostró en estudios anteriores como el realizado en 2011 por J. Nissan et al(45). donde el aflojamiento del tornillo se produjo en un 32% en las restauraciones atornilladas, frente a 9% de las restauraciones cementadas.

Sánchez Acedo C. et al.(23) con un total de 2765 en el 2013, determina que, la mayor parte de las fracturas ocurrieron en prótesis fijas atornilladas, ya que pueden tener un peor reparto de la carga y las prótesis cementadas presenta una menor incidencia de fractura al favorecer un mejor ajuste pasivo, con un mejor reparto de fuerzas.

En contraposición, la revisión sistemática publicada en 2014 por Wittneben JG et al.(46) no se encontró una relación estadísticamente significativa entre las prótesis atornilladas o cementadas y la fractura del tornillo o del implante.

Ajuste pasivo:

Es el que se produce entre el implante y la restauración protésica y se considera como uno de los factores más importantes que determinan el fracaso del tratamiento. Esto se debe, a que el tratamiento con implantes presenta múltiples procesos y en cada uno de ellos se pueden introducir errores casi imperceptibles pero que en conjunto pueden producir un mal ajuste entre el implante y la prótesis favoreciendo su fracaso. Estos procesos son el correcto registro y transferencia de la posición del implante, alteraciones de los materiales empleados como la silicona de impresión o la escayola de vaciado, tipo de cubeta o incluso la destreza y experiencia del odontólogo que instala la prótesis(47–55).

Esta falta de ajuste entre la rehabilitación protésica y el implante se traduce en un aumento de las tensiones no controladas sobre el implante o tornillo, es decir, la presencia de micro-gap o brechas produce una distribución de fuerzas desfavorable entre el implante y la rehabilitación protésica provocando un aumento en la incidencia de aflojamiento o fractura del tornillo o incluso en la fractura del propio implante(56,57).

La mayoría de los estudios tienen como limitación que están realizados *In Vitro* donde las impresiones no se ven afectadas por el tejido blando, sangre o saliva, por tanto, sería necesario investigar mas sobre este tema, realizando estudios *In Vivo* que puedan ser comparados con los estudios *In Vitro.* Debido a que el ajuste del 100% entre el implante y la restauración protésica es imposible, hoy día se considera un rango aceptable de discrepancia de unas 100-150micras(14).

Fuerzas oclusales-parafunciones:

Según el artículo de revisión realizado en 2006 por F. Lobbezoo et al.(58), se desconocen valores exactos de las fuerzas que se producen con el bruxismo, pero sabemos que los implantes dentales carecen de propiocepción, ya que no disponen de ligamento periodontal, produciendo una disminución a la hora de percibir las fuerzas de masticación y, esto podría dar lugar a la sobrecarga de los implantes.

La revisión de la literatura realizada en 2014 por Manfredini D et al.(59) tenia como objetivo relacionar el bruxismo con las complicaciones biomecánicas en implantología a través de la evidencia científica, pero la falta de homogeneidad en el diagnostico o la falta de estudios científicos relevantes hace que, a día de hoy, no exista una evidencia contrastada de la relación directa del bruxismo y las complicaciones biomecánicas en implantología.

Estudios como el realizado por De Boever AL et al.(60) se observó que los pacientes bruxistas portadores de prótesis atornilladas, el 56% de ellas presentaron aflojamiento del tornillo pero no se observo fractura del implante o tornillo, mientras que en el estudio realizado por Tosun et al.(61) en pacientes diagnosticados de bruxismo mediante polysomnografia presentaron fracturas del implante o tornillo y aflojamiento.

Otros autores como Tawil et al. en 2006(62) o Wahlström et al. en 2010(63) no muestran una asociación clara entre el bruxismo y el aumento de la incidencia de fractura del implante o aflojamiento del tornillo. por lo tanto, no existe relación estadísticamente significativa entre el bruxismo y la pérdida del implante, pero es importante realizar una planificación mas meticulosa aun en los pacientes que presentan esta parafunción, con el objetivo de reducir las posibles fuerzas anómalas sobre el tratamiento de implantes. Algunas de las medidas que reducen las fuerzas ejercidas sobre los implantes son, la colocación de un mayor número de implantes(64), evitar las prótesis en voladizo o que los implantes sean mas anchos y largos(65) además, debemos añadir dispositivos tales como la férula nocturna tipo Michigan(65).

En contra de lo mencionado anteriormente, en 2011, en el estudio retrospectivo de 5 años realizado por P. Maló et al.(66), con un total de 995 implantes, se relacionó la sobrecarga de fuerzas producidas en los pacientes bruxistas con el mayor fracaso del tratamiento con implantes. Esto también fue afirmado en la revisión sistemática y meta-análisis publicados en 2016 por Y. Zhou et al.(67) donde, se observa que los pacientes bruxistas presentan mayor incidencia de fractura que los pacientes que no presentan esta parafunción y por tanto, consideran el bruxismo como un factor de riesgo importante en el fallo de los implante dentales.

Por tanto, con los estudios realizados hasta el momento no se puede llegar a la conclusión de que el bruxismo produzca directamente la fractura del implante dental ya que, estos estudios presentan resultados contradictorios y esto puede deberse a su gran heterogeneidad tanto en los factores estudiados como el tipo de implante, tipo de prótesis o tipo de paciente, como en el tiempo, duración y modo de evaluación de resultados junto, con el diseño de los estudios.

8. CONCLUSIONES:

Tras el análisis y comparación de toda la bibliografía obtenida y en respuesta a los objetivos planteados se concluye que:

1. El aflojamiento del tornillo es una complicación mucho mas común pero menos peligrosa que las fracturas. Dicho aflojamiento se considera una complicación más temprana que la fractura, por lo que esta fractura puede ir precedida de un aflojamiento previo.
2. Ambas complicaciones son multifactoriales, es decir, no son causadas por un solo factor de riesgo, sino que son la suma de varios factores los que nos llevan a ellas.
3. Dentro de todos los factores descritos y analizados, cabe destacar el ancho del implante, conexión externa, prótesis unitaria o en voladizo, región molar y la falta de ajuste pasivo.
4. Para disminuir la incidencia de estas complicaciones, no hay que centrarse en un solo factor, si no que se debe realizar una planificación global y minuciosa del tratamiento implantológico, es decir, planificando tanto la cirugía de

colocación del implante como la futura restauración protésica que va a soportar dicho implante.

9. RESPONSABILIDAD:

La presente revisión bibliográfica cumple con los criterios de sostenibilidad mediombiental ya que, se pretende ampliar los conocimientos sobre las causas que favorecen el fracaso del tratamiento implantológico, con el objetivo de poder evitarlo o reducirlo al máximo, mejorando la calidad de vida del paciente.

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10. ANEXO:

Listado de Preguntas de Hábitos Orales

Basado en el último mes ¿qué tan frecuentemente ha realizado las siguientes actividades? Si la frecuencia de la actividad varió, seleccione la opción de mayor frecuencia. Por favor coloque una (X) para cada pregunta y no deje de contestar ninguna de ellas.

	Actividades mientras duerme	Ninguna vez	Menos de una noche por mes	De 1 a 3 noches por mes	De 1 a 3 noches por semana	De 4 a 7 noches por semana
1	Basado en cualquier información que tenga, aprieta o rechina los dientes cuando está dormido.	☐	☐	☐	☐	☐
2	Duerme en alguna posición que ejerza presión sobre la mandíbula (por ejemplo: boca abajo o de lado).	☐	☐	☐	☐	☐
	Actividades mientras estas despierto	**Ninguna vez**	**Pocas veces**	**Algunas veces**	**La mayoría de las veces**	**Todo el tiempo**
3	Rechina los dientes durante las horas que está despierto.	☐	☐	☐	☐	☐
4	Aprieta los dientes durante las horas que está despierto.	☐	☐	☐	☐	☐
5	Presiona, toca o mantiene los dientes juntos, aparte de cuando come (es decir; contacto entre los dientes superiores y los inferiores).	☐	☐	☐	☐	☐
6	Mantiene, aprieta o tensa los músculos sin apretar o juntar los dientes.	☐	☐	☐	☐	☐
7	Mantiene o lleva la mandíbula hacia adelante o de lado.	☐	☐	☐	☐	☐
8	Aprieta la lengua con fuerza contra los dientes.	☐	☐	☐	☐	☐
9	Coloca la lengua entre los dientes.	☐	☐	☐	☐	☐
10	Muerde, mastica o juega con su lengua, mejillas o labios.	☐	☐	☐	☐	☐
11	Mantener la mandíbula en una posición rígida o tensa, como en una posición de protección.	☐	☐	☐	☐	☐
12	Mantiene entre los dientes o muerde objetos como: cabello, pipa, lápices, plumas, dedos, uñas, etc.	☐	☐	☐	☐	☐
13	Usa goma de mascar (mastica chicle).	☐	☐	☐	☐	☐
14	Usa instrumentos musicales que incluyan el uso de la boca o la mandíbula (por ejemplo: instrumentos de viento, metal o de cuerda).	☐	☐	☐	☐	☐
15	Apoya su mano sobre la mandíbula (sostener la barbilla).	☐	☐	☐	☐	☐
16	Mastica solamente de un lado.	☐	☐	☐	☐	☐
17	Come entre comidas (es decir; comidas que requieran de masticación).	☐	☐	☐	☐	☐
18	Su actividad requiere hablar constantemente (profesor, vendedor, servicio al cliente, etc.).	☐	☐	☐	☐	☐
19	Canta.	☐	☐	☐	☐	☐
20	Bosteza.	☐	☐	☐	☐	☐
21	Sostiene el teléfono entre la cabeza y el hombro.	☐	☐	☐	☐	☐

dentistry journal

Article

Fatigue of Dental Implants: Facts and Fallacies

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Abstract: Dental implants experience rare yet problematic mechanical failures such as fracture that are caused, most often, by (time-dependent) metal fatigue. This paper surveys basic evidence about fatigue failure, its identification and the implant's fatigue performance during service. We first discuss the concept of dental implant fatigue, starting with a review of basic concepts related to this failure mechanism. The identification of fatigue failures using scanning electron microscopy follows, to show that this stage is fairly well defined. We reiterate that fatigue failure is related to the implant design and its surface condition, together with the widely varying service conditions. The latter are shown to vary to an extent that precludes devising average or representative conditions. The statistical nature of the fatigue test results is emphasized throughout the survey to illustrate the complexity in evaluating the fatigue behavior of dental implants from a design perspective. Today's fatigue testing of dental implants is limited to ISO 14801 standard requirements, which ensures certification but does not provide any insight for design purposes due to its limited requirements. We introduce and discuss the random spectrum loading procedure as an alternative to evaluate the implant's performance under more realistic conditions. The concept is illustrated by random fatigue testing in 0.9% saline solution.

Keywords: fatigue; dental implants; spectrum loading; fracture; complications

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Review

OXFORD

A pore way to heal and regenerate: 21st century thinking on biocompatibility

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Abstract

This article raises central questions about the definition of biocompatibility, and also about how we assess biocompatibility. We start with the observation that a porous polymer where every pore is spherical, ~40 microns in diameter and interconnected, can heal into vascularized tissues with little or no fibrosis and good restoration of vascularity (i.e., little or no foreign body reaction). The same polymer in solid form will trigger the classic foreign body reaction characterized by a dense, collagenous foreign body capsule and low vascularity. A widely used definition of biocompatibility is 'the ability of a material to perform with an appropriate host response in a specific application'. With precision-porous polymers, in direct comparison with the same polymer in solid form, we have the same material, in the same application, with two entirely different biological reactions. Can both reactions be 'biocompatible?' This conundrum will be elaborated upon and proposals will be made for future considerations and measurement of biocompatibility.

Keywords: biocompatibility; foreign body reaction; pore; healing; regeneration

Diseño de los implantes dentales: Estado actual

MARTÍNEZ-GONZÁLEZ JM
CANO SÁNCHEZ J
CAMPO TRAPERO J
MARTÍNEZ-GONZÁLEZ MJS
GARCÍA-SABÁN F

Martínez-González JM, Cano Sánchez J, Campo Trapero J, Martínez-González MJS, García-Sabán F. Diseño de los implantes dentales: Estado actual. Av Periodon Implantol. 2002; 14, 3: 129-136.

RESUMEN

El diseño de los implantes dentales se están modificando continuamente debido a razones clínico-científicas y comerciales. Se realiza un revisión de la literatura en relación a las implicaciones clínicas y biológicas de las variaciones en macrogeometría y su influencia en la interfase con la mucosa y el hueso.

Los resultados descritos en la literatura muestran que los nuevos diseños de implantes mejoran la estabilidad primaria en huesos de baja densidad y distribuyen mejor las cargas biomecánicas. Existen diseños que favorecen la colocación de implantes en defectos de la anatomía alveolar y alveólos postextracción. Los resultados experimentales y clínicos evidencian un beneficio para diseños que eliminan el cuello pulido, con cuerpo cónico, con ápice autorroscante, a base de dobles o triples espiras y perfiles de rosca redondeadas.

PALABRAS CLAVE

Diseño, macrogeometría, implante.

DENTAL MEDICINE

Principles of biomechanics in oral implantology

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Abstract

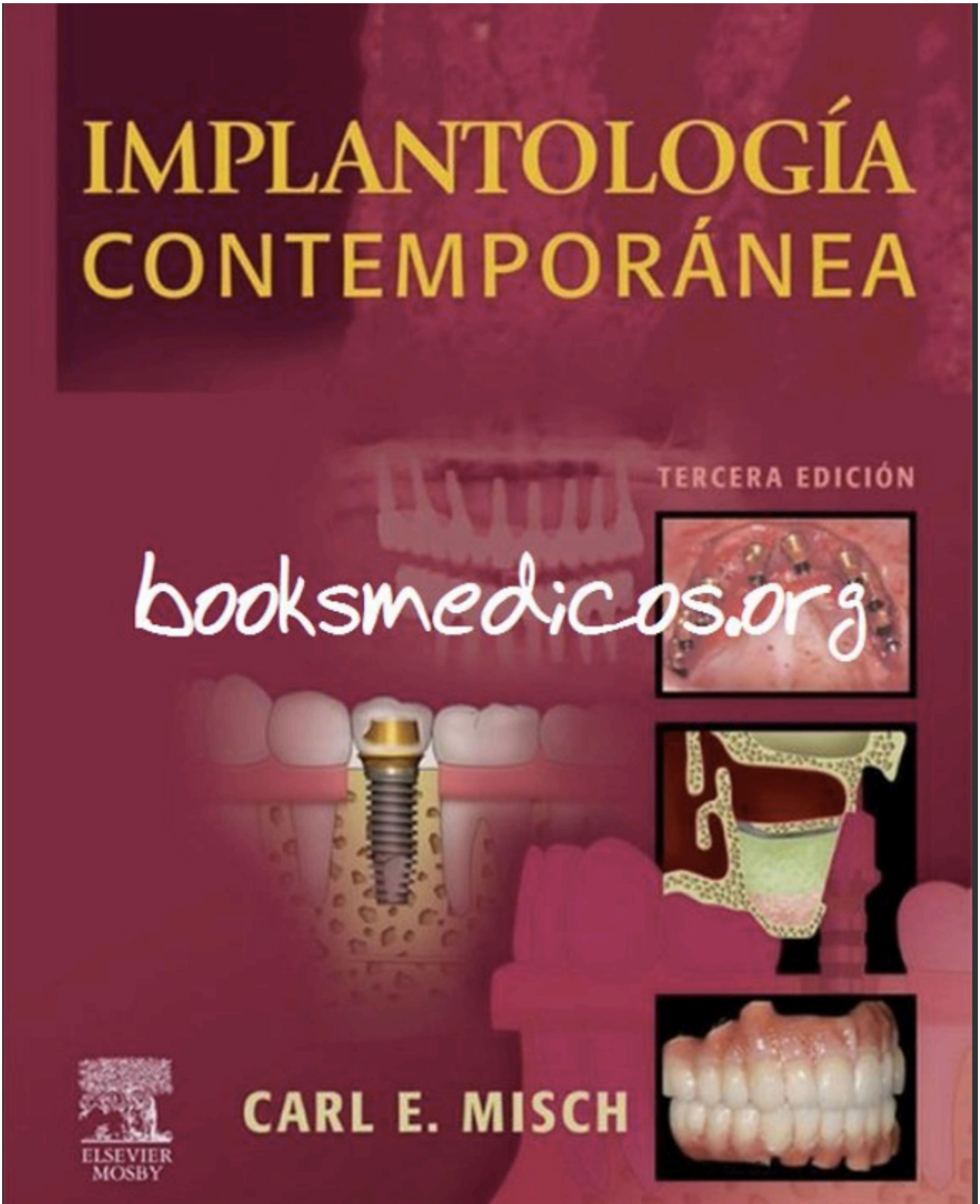
Background and aims. The principles of biomechanics comprise all the interactions between the body (tissues) and the forces acting upon it (directly or via different medical devices). Besides the mechanical aspects, the tissues response is also studied. Understanding and applying these principles is vital for the researchers in the field of oral implantology, but they must be equally known by the practitioners. From the planning stages to the final prosthetic restoration, they are involved in each and every aspect. Ignoring them inevitably leads to failure.

Methods. The first part of this paper includes a review of our current research in oral implantology (mechanical, digital and biological testing), while the second part includes a review of the available literature on certain biomechanical aspects and their implications in everyday practice.

Results. Our research opens new study directions and provides increased chances of success for dental implant therapy. The practical aspects of our findings, combined with the available literature (from the basic principles described more than 40 years ago to the most recent studies and technologies) can serve as a guide to practitioners for increasing their success rate.

Conclusion. While no therapy is without failure risk, a good understanding of the biomechanics involved in oral implantology can lead to higher success rates in implant supported prosthetic restorations.

Keywords: oral implantology, biomechanics, bone augmentation


IMPLANTOLOGÍA
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MOSBY

REVIEW ARTICLE

Biomaterials and Biomechanics of Oral and Maxillofacial Implants: Current Status and Future Developments

John B. Brunski, MS, PhD[1]/David A. Puleo, PhD[2]/Antonio Nanci, MSc, PhD[3]

Major advances have occurred over the last 3 decades in the clinical use of oral and maxillofacial implants. Statistics on the use of dental implants bear this out; about 100,000 to 300,000 dental implants are placed per year,[1] which approximates the numbers of artificial hip and knee joints placed per year.[2] Implants are currently used to replace missing teeth, rebuild the craniofacial skeleton, provide anchorage during orthodontic treatments, and even to help form new bone in the process of distraction osteogenesis.

Despite the impressive clinical accomplishments with oral and maxillofacial implants—and the undisputed fact that implants have improved the lives of millions of patients—it is nevertheless disquieting that key information is still missing about fundamental principles underlying their design and clinical use. With some important exceptions, the design and use of oral and maxillofacial implants has often been driven by an aggressive, "copycat" marketing environment, rather than by basic advances in biomaterials, biomechanics, or bone biology.

A wide variety of implants now exists for use in many clinical indications, with over 50 companies listed by the United States Food and Drug Administration (FDA) as being involved in the manufacture, marketing, and distribution of dental implants. While this situation is not necessarily a problem, in many instances new companies have entered the dental implant market by simply copying or making minor, incremental changes to the sizes, shapes, materials, and surfaces of competitors' products, while exaggerating the new product's effectiveness. In addition, busy clinicians, not always equipped to discern the difference between marketing hype and scientific advance, yet wanting to help their patients sooner rather than later, have often been too eager to use new implants in new clinical situations before these new indications have been fully researched from the clinical or basic science viewpoint. For better or for worse, the current state of the oral implant field is such that a myriad of different types of implants are now being used in a very wide variety of clinical indications, under largely undocumented loading conditions in different quantities and qualities of bone that has healed to varying extents. It is a fertile but complicated state of affairs.

Given this situation and the many variables that can affect the performance of oral implants, it is sometimes difficult to separate fact from fiction and make reliable predictions for the future. However, a helpful starting point is to appreciate that the use of oral implants—and the key role of biomaterials and biomechanics—is an excellent example of a multifaceted design problem.

TREATMENT PLANNING WITH ORAL IMPLANTS AS A DESIGN PROBLEM: AN OFTEN-IGNORED PERSPECTIVE

A guiding perspective is that the clinical use of implants is a design problem in the true sense of the word. Two key characteristics distinguish design problems.[3] First, design problems are open-ended, which means that they typically have more than one possible solution: "The quality of uniqueness, so important in many mathematics and analysis problems, simply does not apply."[3] Second, design problems are ill-structured, which means that "their

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Clinical study on screw loosening in dental implant prostheses: a 6-year retrospective study

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Affiliations + expand

PMID: 32364353 PMCID: PMC7222622 DOI: 10.5125/jkaoms.2020.46.2.133

Abstract

Objectives: In this study, we determined the incidence and pattern of screw loosening in patients who received dental implants.

Materials and methods: Patients who received implants between January 2008 and October 2013 and completed their prosthetic rehabilitation were evaluated for the incidence, frequency, and onset of screw loosening using dental charts and radiographs. The association between each factor and screw loosening was analyzed using the chi-square test and a multivariate analysis with binary logistic regression models ($P<0.05$).

Results: Total 1,928 implants were placed in 837 patients (448 males, 389 females), whose follow-up period after loading varied from 0.25 to 70 months (mean period, 31.5 months). Screw loosening occurred in 7.2% of implants. Most cases occurred less than six months after loading. Among those, 22.3% experienced recurrent screw loosening. Screw loosening was most common in the molar region (8.5%) and frequently associated with an implant diameter of ≥5 mm (14.2%). External implant-abutment connections (8.9%) and screw-retained implant prostheses (10.1%) showed higher incidence of problems than internal implant-abutment connections and cement-retained implants, respectively. Screw loosening was most common in implant prostheses with single crowns (14.0%).

Conclusion: Within the limits of the current study, we conclude that the incidence of screw loosening differs significantly according to the position of implant placement, the type of implant and manufacturer, implant diameter, the type of implant-abutment connection, the type of retention in the implant prosthesis, and the type of implant prosthesis.

CLINICAL ORAL IMPLANTS RESEARCH

Review

A systematic review and meta-analysis of removable and fixed implant-supported prostheses in edentulous jaws: post-loading implant loss

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Key words: edentulous mandible, edentulous maxilla, implant-supported prosthesis, meta-analysis, systematic review

Abstract

Objectives: The aim of this systematic review was to analyze post-loading implant loss for implant-supported prostheses in edentulous jaws, regarding a potential impact of implant location (maxilla vs. mandible), implant number per patient, type of prosthesis (removable vs. fixed), and type of attachment system (screw-retained, ball vs. bar vs. telescopic crown).

Material and methods: A systematic literature search for randomized-controlled trials (RCTs) or prospective studies was conducted within PubMed, Cochrane Library, and Embase. Quality assessment of the included studies was carried out, and the review was structured according to PRISMA. Implant loss and corresponding 3- and 5-year survival rates were estimated by means of a Poisson regression model with total exposure time as offset.

Results: After title, abstract, and full-text screening, 54 studies were included for qualitative analyses. Estimated 5-year survival rates of implants were 97.9% [95% CI 97.4; 98.4] in the maxilla and 98.9% [95% CI 98.7; 99.1] in the mandible. Corresponding implant loss rates per 100 implant years were significantly higher in the maxilla (0.42 [95% CI 0.33; 0.53] vs. 0.22 [95% CI 0.17; 0.27]; $P = 0.0001$). Implant loss rates for fixed restorations were significantly lower compared to removable restorations (0.23 [95% CI 0.18; 0.29] vs. 0.35 [95% CI 0.28; 0.44]; $P = 0.0148$). Four implants and a fixed restoration in the mandible resulted in significantly higher implant loss rates compared to five or more implants with a fixed restoration. The analysis of one implant and a mandibular overdenture also revealed higher implant loss rates than an overdenture on two implants. The same (lower implant number = higher implant loss rate) applied when comparing 2 vs. 4 implants and a mandibular overdenture. Implant loss rates for maxillary overdentures on <4 implants were significantly higher than for four implants (7.22 [95% CI 5.41; 9.64] vs. 2.31 [1.56; 3.42]; $P < 0.0001$).

Conclusions: Implant location, type of restoration, and implant number do have an influence on the estimated implant loss rate. Consistent reporting of clinical studies is necessary and high-quality studies are needed to confirm the present results.

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Review

Early in contrast to recent methods to evaluate masticatory function in implant patients☆

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Abstract

Purpose: The aim was to describe early and a few recent methods to evaluate masticatory function in patients before and after implant treatment.
Study selection: Three Swedish doctoral theses from the early era of osseointegration and a recent Swedish doctoral thesis studying oral function in implant patients are reviewed. Furthermore, a PubMed search was conducted to identify studies published during the last 3 years related to masticatory function in implant patients.
Results: The first studies used questionnaires and methods for assessing bite force and chewing efficiency before and after implant treatment. Subsequent studies included methods evaluating dietary selection, psychological problems, occlusal perception, oral stereognosis, oral motor ability and phonetics. The results demonstrated overwhelming improvement, both subjectively and objectively, of oral functions, and in the patients' lives, after implant treatment. The methods employed appear to have been adequate and they have continued to be utilized, only slightly modified, in a number of subsequent and recent studies. New methods using custom-made equipment to monitor changes in bite force, jaw movements and muscle activity during various tasks demonstrated the important role of periodontal mechanoreceptors in biting and chewing. These methods promise to be valuable in ongoing and future prosthodontic research.
Conclusions: The early methods used for assessment of masticatory function appear to have been adequate and they have, with only slight modifications, continued to be utilized. New methods monitoring bite force, jaw movements and muscle activity have deepened the knowledge of masticatory functions and promise to be valuable in future prosthodontic research.

Keywords: Bite force; Biting; Chewing efficiency; Occlusal perception; Osseoperception

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PMID: 24604993

Passive Fit in Screw Retained Multi-unit Implant Prosthesis Understanding and Achieving: A Review of the Literature

Muaiyed Mahmoud Buzayan and Norsiah Binti Yunus

Abstract

Go to:

One of the considerable challenges for screw-retained multi-unit implant prosthesis is achieving a passive fit of the prosthesis' superstructure to the implants. This passive fit is supposed to be one of the most vital requirements for the maintenance of the osseointegration. On the other hand, the misfit of the implant supported superstructure may lead to unfavourable complications, which can be mechanical or biological in nature. The manifestations of these complications may range from fracture of various components in the implant system, pain, marginal bone loss, and even loss of osseointegration. Thus, minimizing the misfit and optimizing the passive fit should be a prerequisite for implant survival and success. The purpose of this article is to present and summarize some aspects of the passive fit achieving and improving methods. The literature review was performed through Science Direct, Pubmed, and Google database. They were searched in English using the following combinations of keywords: passive fit, implant misfit and framework misfit. Articles were selected on the basis of whether they had sufficient information related to framework misfit's related factors, passive fit and its achievement techniques, marginal bone changes relation with the misfit, implant impression techniques and splinting concept. The related references were selected in order to emphasize the importance of the passive fit achievement and the misfit minimizing. Despite the fact that the literature presents considerable information regarding the framework's misfit, there was not consistency in literature on a specified number or even a range to be the acceptable level of misfit. On the other hand, a review of the literature revealed that the complete passive fit still remains a tricky goal to be achieved by the prosthodontist.

Keywords: Passive fit, Misfit, Implant, Splinting

Cement-Retained Versus Screw-Retained Implant Restorations: A Critical Review

Konstantinos X. Michalakis, DDS, PhD[1]/Hiroshi Hirayama, DDS, DMD, MS[2]/Pavlos D. Garefis, DDS, PhD[3]

This article presents a comparison of screw-retained and cement-retained implant prostheses based on the literature. The advantages, disadvantages, and limitations of the 2 different types of restorations are discussed, because it is important to understand the influence of the attachment mechanism on many clinical aspects of implant dentistry. Several factors essential to the long-term success of any implant prosthesis were reviewed with regard to both methods of fixation. These factors include: (1) ease of fabrication and cost, (2) passivity of the framework, (3) retention, (4) occlusion, (5) esthetics, (6) delivery, and (7) retrievability. (More thatn 50 references) INT J ORAL MAXILLOFAC IMPLANTS 2003;18:719–728

Key words: *dental cement, dental implants, dental screw, denture retention, implant-retained dental prosthesis*

The accuracy of implant impressions: A systematic review

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Statement of problem. Various implant impression techniques, such as the splint, pick-up, and transfer techniques, have been introduced, and some techniques may be more accurate than others. Also, clinically, some factors, including the angulation or depth of implants, may affect the accuracy of the implant impressions.

Purpose. The purposes of this review were to: (1) investigate the accuracy of published implant impression techniques, and (2) examine the clinical factors affecting implant impression accuracy.

Material and methods. An electronic search was performed in June 2008 of MEDLINE, EMBASE, and Cochrane Library databases with the key words implant, implants, impression, and impressions. To be included, the study had to investigate the accuracy of implant impressions and be published in an English peer-reviewed journal. In addition, a hand search was performed to enrich the results for the time period from January 1980 to May 2008. After executing the search strategies, 41 articles were selected to be included in the review process.

Results. All of the selected articles were in vitro studies. Of the 17 studies that compared the accuracy between the splint and nonsplint techniques, 7 advocated the splint technique, 3 advocated the nonsplint technique, and 7 reported no difference. Fourteen studies compared the accuracy of pick-up and transfer impression techniques, and 5 showed more accurate impression with the pick-up techniques, 2 with the transfer technique, and 7 showed no difference. The number of implants affected the comparison of the pick-up and splint techniques. Eleven studies compared the accuracy of polyether and vinyl polysiloxane (VPS), and 10 of 11 reported no difference between the 2 materials. Four studies examined the effect of implant angulation on the accuracy of impressions. Two studies reported higher accuracy with straight implants, while the other 2 reported there was no angulation effect.

Conclusions. The review of abutment level or implant level internal connection implants indicated that more studies reported greater accuracy with the splint technique than with the nonsplint technique. For situations in which there were 3 or fewer implants, most studies showed no difference between the pick-up and transfer techniques, whereas for 4 or more implants, more studies showed higher accuracy with the pick-up technique. Polyether and VPS were the recommended materials for the implant impressions. (J Prosthet Dent 2008;100:285-291)

Passive fit and accuracy of three dental implant impression techniques

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Affiliations + expand

PMID: 22257873

Abstract

Objective: To reassess the accuracy of three impression techniques relative to the passive fit of the prosthesis.

Method and materials: An edentulous maxillary cast was fabricated in epoxy resin with four dental implants embedded and secured with heat-cured acrylic resin. Three techniques were tested: closed tray, open tray nonsplinted, and open tray splinted. One light-cured custom acrylic tray was fabricated for each impression technique, and transfer copings were attached to the implants. Fifteen impressions for each technique were prepared with medium-bodied consistency polyether. Subsequently, the impressions were poured in type IV die stone. The distances between the implants were measured using a digital micrometer. The statistical analysis of the data was performed with ANOVA and a one-sample t test at a 95% confidence interval.

Results: The lowest mean difference in dimensional accuracy was found within the direct (open tray) splinted technique. Also, the one-sample t test showed that the direct splinted technique has the least statistical significant difference from direct nonsplinted and indirect (closed tray) techniques. All discrepancies were less than 100 Mm.

Conclusion: Within the limitations of this study, the best accuracy of the definitive prosthesis was achieved when the impression copings were splinted with autopolymerized acrylic resin, sectioned, and rejoined. However, the errors associated with all of these techniques were less than 100 Mm, and based on the current definitions of passive fit, they all would be clinically acceptable.

The effect of oral-like environment on dental implants' fatigue performance

Keren Shemtov-Yona [1], Daniel Rittel, Liran Levin, Eli E Machtei

Affiliations + expand

PMID: 23278444 DOI: 10.1111/clr.12084

Abstract

Aim and objectives: The aim of this study was to evaluate the influence of fluid environment mimicking intra-oral conditions on fatigue performance of standard diameter, 3.75-mm implants. Dental implants placed intra-orally are repeatedly submitted to mastication loads in the oral environment, which differ substantially from room-air standard laboratory conditions. Several studies that examined fracture surfaces of intra-orally fractured dental implants have identified corrosion fatigue as the main failure mechanism. Yet, fatigue performance of dental implants has been essentially studied in room air, based on the premise that the implant material is relatively resistant to corrosion in the intra-oral environment.

Material and methods: Thirty-two 3.75-mm titanium alloy implants were tested under cyclic compressive loading. The tests were performed in artificial saliva substitute containing 250 ppm of fluoride. The loading machine stopped running when the implant structure collapsed or when it completed 5 × 10(6) cycles without apparent failure. The load vs. number of cycles was plotted as curve for biomechanical fatigue analysis (S-N curve). The S-N curve plotted for the artificial saliva test was compared to the curve obtained previously for the same implants tested in a room-air environment. Failure analysis was performed using scanning electron microscopy (SEM).

Results: A comparison of the S-N curves obtained in artificial saliva and in room air showed a considerable difference. The S-N curve obtained in the artificial saliva environment showed a finite life region between 535N and 800N. The transition region was found below 465N, with a probability of survival of 50%, while in room air, the transition region was between 810N and 620N and an infinite life region below 620N was identified.

Conclusions: The results of this study show that environmental conditions adversely affect implants' fatigue performance. This fact should be taken into account when evaluating the mechanical properties of dental implants.

Keywords: S-N curve; cycles; fluoride; load; probability of fracture; saliva substitute.

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Effect of different lateral occlusion schemes on peri-implant strain: A laboratory study

Jennifer Lo, Jaafar Abduo,[✉] and Joseph Palamara

Abstract

Go to:

PURPOSE

This study aims to investigate the effects of four different lateral occlusion schemes and different excursions on peri-implant strains of a maxillary canine implant.

MATERIALS AND METHODS

Four metal crowns with different occlusion schemes were attached to an implant in the maxillary canine region of a resin model. The included schemes were canine-guided (CG) occlusion, group function (GF) occlusion, long centric (LC) occlusion, and implant-protected (IP) occlusion. Each crown was loaded in three sites that correspond to maximal intercuspation (MI), 1 mm excursion, and 2 mm excursion. A load of 140 N was applied on each site and was repeated 10 times. The peri-implant strain was recorded by a rosette strain gauge that was attached on the resin model buccal to the implant. For each loading condition, the maximum shear strain value was calculated.

RESULTS

The different schemes and excursive positions had impact on the peri-implant strains. At MI and 1 mm positions, the GF had the least strains, followed by IP, CG, and LC. At 2 mm, the least strains were associated with GF, followed by CG, LC, and IP. However, regardless of the occlusion scheme, as the excursion increases, a linear increase of peri-implant strains was detected.

CONCLUSION

The peri-implant strain is susceptible to occlusal factors. The eccentric location appears to be more influential on peri-implant strains than the occlusion scheme. Therefore, adopting an occlusion scheme that can reduce the occurrence of occlusal contacts laterally may be beneficial in reducing peri-implant strains.

Keywords: Canine guidance, Dental occlusion, Centric occlusion

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Review

Biological factors contributing to failures of osseointegrated oral implants

(I). Success criteria and epidemiology

Marco Esposito[1,2], Jan-Michaél Hirsch[2], Ulf Lekholm[3], Peter Thomsen[1]

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Esposito M, Hirsch J-M, Lekholm U, Thomsen P: Biological factors contributing to failures of osseointegrated oral implants. (I) Success criteria and epidemiology. Eur J Oral Sci 1998; 106: 527–551. © Eur J Oral Sci, 1998

The aim of this review was to offer a critical evaluation of the literature and to provide the clinician with scientifically-based diagnostic criteria for monitoring the implant condition. The review presents the current opinions on definitions of osseointegration and implant failure. Further, distinctions between failed and failing implants are discussed together with the presently used parameters to assess the implant status. Radiographic examinations together with implant mobility tests seem to be the most reliable parameters in the assessment of the prognosis for osseointegrated implants. On the basis of 73 published articles, the rates of early and late failures of Brånemark implants, used in various anatomical locations and clinical situations, were analyzed using a metanalytic approach. Biologically related implant failures calculated on a sample of 2,812 implants were relatively rare: 7.7% over a 5-year period (bone graft excluded). The predictability of implant treatment was remarkable, particularly for partially edentulous patients, who showed failure rates about half those of totally edentulous subjects. Our analysis also confirmed (for both early and late failures) the general trend of maxillas, having almost 3 times more implant losses than mandibles, with the exception of the partially edentulous situation which displayed similar failure rates both in upper and lower jaws. Surgical trauma together with anatomical conditions are believed to be the most important etiological factors for early implant losses (3.6% of 16,935 implants). The low prevalence of failures attributable to peri-implantitis found in the literature together with the fact that, in general, partially edentulous patients have less resorbed jaws, speak in favour of jaw volume, bone quality, and overload as the three major determinants for late implant failures in the Brånemark system. Conversely, the ITI system seemed to be characterized by a higher prevalence of losses due to peri-implantitis. These differences may be attributed to the different implant designs and surface characteristics. On the basis of the published literature, there appears to be a number of scientific issues which are yet not fully understood. Therefore, it is concluded that further clinical follow-up and retrieval studies are required in order to achieve a better understanding of the mechanisms for failure of osseointegrated implants.

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Key words: dental implants; osseointegration; medical device failure; metanalysis

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Original

Riesgo de fractura implantaria en relación con el diámetro y la plataforma del implante: estudio clínico y analítico de una serie de 33 casos

Celia Sánchez Acedo [a,*], *Luis Naval Gías* [b], *Beatriz Naval Parra* [c] y *Ana Capote Moreno* [a]

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RESUMEN

Objetivos: Evaluar la importancia del diseño del implante en el desarrollo de la fractura, en cuanto al tipo de conexión protésica y la diferencia de diámetros entre la plataforma y el cuerpo del implante.

Material y métodos: Se analiza un grupo de 33 implantes fracturados entre los años 2000 y 2009. Se recogen los datos relacionados con el implante y la rehabilitación protésica, y se compararon la existencia de diferencias significativas entre el tipo de conexión del implante y entre el tipo de plataforma para los implantes de conexión externa (diámetro 3,75 mm o superior frente a 3,4 mm de plataforma 4,1).

Resultados: Las 33 fracturas acontecieron en un total de 23 pacientes, 13 de estas fracturas (8 pacientes) provenían de otros centros y las 20 restantes (15 pacientes) se recogieron sobre un total de 2.765 implantes colocados en nuestra consulta. Dentro de este grupo, se comparó la frecuencia de fractura de los implantes de 3,4 mm frente a los de 3,75 mm o superior (ambos con la misma plataforma de 4,1 mm), encontrando diferencias significativas entre ambos grupos ($p = 0,02$). Sin embargo, no se encontraron diferencias entre la conexión protésica externa frente a la interna ($p = 0,7$).

Conclusiones: La fractura implantaria es una complicación infrecuente. La incidencia en nuestro grupo de pacientes fue del 0,72%. El riesgo de fractura se relaciona con el diseño del implante, y es elevado en implantes que tienen gran diferencia de diámetros entre la zona superior y el cuerpo, es decir, en implantes estrechos que tienen una plataforma ancha. El tipo de conexión protésica parece no tener relación.

Keywords:
Implant failure
Implant fracture

ABSTRACT

Purpose: The purpose of this study is to evaluate the importance of implant design in regard of the type of prosthetic connection and the platform-diameter implant body-diameter ratio, in the development of implant fracture (IF).

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Two-visit CAD/CAM milled dentures in the rehabilitation of edentulous arches: A case series

Anish Varkey John, George Abraham,[1] and Anumol Alias

Abstract

Go to:

Computer-aided design-computer-aided manufacturing (CAD-CAM) has now found its place in the field of removable prosthodontics with the advent of its use in the fabrication of complete dentures. The conventional technique, by injection or compression molding using heat-polymerized resins, requires cumbersome laboratory procedures and up to five patient visits. For patients with time constraints and clinicians with a higher throughput rate, the CAD-CAM approach with a digital workflow can reduce the number of appointments and ensure speedy delivery of the prosthesis. This article describes the rehabilitation of completely edentulous arches using the Baltic Denture System (Merz Dental GmbH®) in just two patient visits.

Keywords: Baltic denture system, computer-aided design-computer-aided manufacturing, edentulous, rehabilitation

A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years

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Affiliations + expand

PMID: 15533124 DOI: 10.1111/j.1600-0501.2004.01117.x

Abstract

Objectives: The objective of this systematic review was to assess the 5- and 10-year survival of implant supported fixed partial dentures (FPDs) and to describe the incidence of biological and technical complications.

Methods: An electronic MEDLINE search complemented by manual searching was conducted to identify prospective and retrospective cohort studies on FPDs with a mean follow-up time of at least 5 years. Patients had to have been examined clinically at the follow-up visit. Assessment of the identified studies and data abstraction was performed independently by two reviewers. Failure and complication rates were analyzed using random-effects Poisson regression models to obtain summary estimates of 5- and 10-year survival proportions.

Results: The search provided 3844 titles and 560 abstracts. Full-text analysis was performed for 176 articles resulting in 21 studies that met the inclusion criteria. Meta-analysis of these studies indicated an estimated survival of implants in implant-supported FPDs of 95.4% (95 percent confidence interval (95% CI): 93.9-96.5%) after 5 and 92.8% (95% CI: 90-94.8%) after 10 years. The survival rate of FPDs supported by implants was 95% (95% CI: 92.2-96.8%) after 5 and 86.7% (95% CI: 82.8-89.8%) after 10 years of function. Only 61.3% (95% CI: 55.3-66.8%) of the patients were free of any complications after 5 years. Peri-implantitis and soft tissue complications occurred in 8.6% (95% CI: 5.1-14.1%) of FPDs after 5 years. Technical complications included implant fractures, connection-related and suprastructure-related complications. The cumulative incidence of implant fractures after 5 years was 0.4% (95% CI: 0.1-1.2%). After 5 years, the cumulative incidence of connection-related complications (screw loosening or fracture) was 7.3% and 14% for suprastructure-related complications (veneer and framework fracture).

Conclusion: Despite a high survival of FPDs, biological and technical complications are frequent. This, in turn, means that substantial amounts of chair time have to be accepted by the clinician following the incorporation of implant-supported FPDs. More studies with follow-up times of 10 and more years are needed as only few studies have described the long-term outcomes.

Clinical complications with implants and implant prostheses

Charles J. Goodacre, DDS, MSD,[a] Guillermo Bernal, DDS, MSD,[b] Kitichai Rungcharassaeng, DDS, MS,[c] and Joseph Y. K. Kan, DDS, MS[d]
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The purpose of this article is to identify the types of complications that have been reported in conjunction with endosseous root form implants and associated implant prostheses. A Medline and an extensive hand search were performed on English-language publications beginning in 1981. The searches focused on publications that contained clinical data regarding success/failure/complications. The complications were divided into the following 6 categories: surgical, implant loss, bone loss, peri-implant soft tissue, mechanical, and esthetic/phonetic. The raw data were combined from multiple studies and means calculated to identify trends noted in the incidences of complications. The most common implant complications (those with a greater than a 15% incidence) were loosening of the overdenture retentive mechanism (33%), implant loss in irradiated maxillae (25%), hemorrhage-related complications (24%), resin veneer fracture with fixed partial dentures (22%), implant loss with maxillary overdentures (21%), overdentures needing to be relined (19%), implant loss in type IV bone (16%), and overdenture clip/attachment fracture (16%). It was not possible to calculate an overall complications incidence for implant prostheses because there were not multiple clinical studies that simultaneously evaluated all or most of the categories of complications. Although the implant data had to be obtained from different studies, they do indicate a trend toward a greater incidence of complications with implant prostheses than single crowns, fixed partial dentures, all-ceramic crowns, resin-bonded prostheses, and posts and cores. (J Prosthet Dent 2003;90:121-32.)

A 10-year retrospective comparative human study on screw-retained versus cemented dental implant abutments

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Affiliations + expand

PMID: 31204452

Abstract

The aim of this 10-year retrospective study was to evaluate the long-term reliability, survival rate and mechanical and biological complications of single-crown implant rehabilitations with two different types of fixture-abutment connections: screw-retained abutments (SRAs) with internal hexagonal connection, and cemented retained abutments (CRAs). A total of 300 single implant-supported crowns were analysed, which had been inserted between 2004 and 2007. Patients were classified according to two groups: the SRA group (n = 150) and the CRA group (n = 150). The primary outcome was marginal bone loss (MBL) on peri-apical radiographs. Bleeding on probing (BOP) and probing depth (PD) were also evaluated. Moreover, prosthetic complications were recorded. Analysis of variance (ANOVA) was used to evaluate the differences between the groups. The overall implant failure rate was 4.2%. The overall positive BOP index was 81.9% of the sites under investigation, as 83.4% for SRA and 80.4% for CRA. Moreover, >5 mm PD demonstrated a rate of 21.0% for CRA, and 13.8% for SRA. The primary outcome of mean MBL was 2.09±1.07 mm for SRA and 1.54±1.20 mm for CRA. Analysis of variance of MBL showed statistical significance for the difference between these two groups (P less than 0.001). For the mechanical aspects, an overall 12.5% of complications occurred. No implant or abutment fractures were recorded. Although complications occurred, the results from this 10-year retrospective study show that these two methods have positive long-term follow-up. With MBL significantly greater for the SRA group than the CRA group, the clinical use of CRA is encouraged in terms of the lower bone resorption rate.

Keywords: cemented retained abutment; fixture-abutment connection; implant survival rate; long-term follow-up; peri-implant bone resorption; screw retained abutment.

A 5-Year Retrospective Assay of Implant Treatments in Private Practice: The Restorative Complications of Long-Span Implant-Supported Fixed and Removable Dental Prostheses

Vahed Parzham, Roy B Judge, Denise Bailey

PMID: 32956430 DOI: 10.11607/ijp.5554

Abstract

Purpose: To describe and analyze the restorative complications of long-span (> three units) implant-supported dental prostheses (LIDPs) in 27 private practices in the state of Victoria, Australia, during the period from January 1, 2005, to December 31, 2009.

Materials and methods: Private dental practitioners providing implant treatment were invited to enroll in this study, which was conducted through a dental practice-based research network. Clinical records of the implant treatments, which were provided during the specified period, were accessed for data collection. LIDPs included implant-supported prostheses of fixed or removable design; namely, fixed partial dentures (IFPDs), fixed complete dentures (IFCDs), removable partial dentures (IRPDs), and complete overdentures (IODs). Descriptive statistics and generalized linear mixed modeling were used for data analysis.

Results: The range of observation time for 627 LIDPs was 3 to 72 months (mean ± SD: 3.22 ± 1.49 years). For fixed prostheses, the complication with the highest annual rate was veneer fracture (acrylic: 21%; ceramic: 2.9%), followed by loss of retention for cement-retained IFPDs (14.7%). For mandibular IODs, the highest annual complication rate was for retention complications, whereas for maxillary IODs, it was for acrylic veneer fracture (11.5% and 6.4%, respectively). The peak incidence of complications was during the first year of function in fixed protheses and in IODs. Acrylic veneer fracture in IFCDs and IOD base fracture were more common in patients with preoperative clinician-reported attrition (estimated odds ratios [ORs] = 4.5 and 11.3, respectively; $P < .05$). Ceramic veneer fracture in fixed protheses and acrylic veneer fracture in IODs were reported more commonly for maxillary compared to mandibular prostheses (ORs = 5 and 22, respectively; $P < .05$). Mandibular IODs had more frequent retention complications when supported by two compared to four implants (OR = 5.9, $P < .05$).

Influence of the implant-abutment connection design and diameter on the screw joint stability

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Affiliations + expand

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Abstract

Purpose: This study was conducted to evaluate the influence of the implant-abutment connection design and diameter on the screw joint stability.

Materials and methods: Regular and wide-diameter implant systems with three different joint connection designs: an external butt joint, a one-stage internal cone, and a two-stage internal cone were divided into seven groups (n=5, in each group). The initial removal torque values of the abutment screw were measured with a digital torque gauge. The postload removal torque values were measured after 100,000 cycles of a 150 N and a 10 Hz cyclic load had been applied. Subsequently, the rates of the initial and postload removal torque losses were calculated to evaluate the effect of the joint connection design and diameter on the screw joint stability. Each group was compared using Kruskal-Wallis test and Mann-Whitney U test as post-hoc test ($\alpha=0.05$).

Results: THE POSTLOAD REMOVAL TORQUE VALUE WAS HIGH IN THE FOLLOWING ORDER WITH REGARD TO MAGNITUDE: two-stage internal cone, one-stage internal cone, and external butt joint systems. In the regular-diameter group, the external butt joint and one-stage internal cone systems showed lower postload removal torque loss rates than the two-stage internal cone system. In the wide-diameter group, the external butt joint system showed a lower loss rate than the one-stage internal cone and two-stage internal cone systems. In the two-stage internal cone system, the wide-diameter group showed a significantly lower loss rate than the regular-diameter group ($P<.05$).

Conclusion: The results of this study showed that the external butt joint was more advantageous than the internal cone in terms of the postload removal torque loss. For the difference in the implant diameter, a wide diameter was more advantageous in terms of the torque loss rate.

Keywords: External butt joint connection; Internal connection; Platform switching; Postload removal torque value.

Screw Loosening for Standard and Wide Diameter Implants in Partially Edentulous Cases: 3- to 7-Year Longitudinal Data

Sang-Choon Cho, DDS,* Paula-Naomi Small DDS, MPH,† Nicolas Elian, DDS,‡ and Dennis Tarnow, DDS§

Screw loosening is considered to be a common problem with both screw - retained and cemented implant restorations. A wider abutment platform, as well as using a torque driver to tighten specifically designed screws may help prevent this loosening. However, there has been no clinical study evaluating either of these. To longitudinally compare the frequency of screw loosening in standard diameter, (3.75 and 4.0 mm) implant supported prostheses to that of wide diameter, (5.0 and 6.0 mm) implant supported prostheses that were hand tightened, and to evaluate whether using a torque driver would minimize or prevent this problem, if screw loosening occurred. A total of 213 dental implants in 106 patients were included in this prospective longitudinal study. Of the implants 68 were wide diameter and 145 were standard diameter implants. Wide diameter implants showed 5.8% screw loosening, while standard diameter implants showed 14.5% screw loosening after insertion with only hand torquing. When these loose screws were tightened with a torque driver, there was no more loosening of screws. Within the limitations of this study, the wide diameter implants tested showed less screw loosening than the standard diameter implants when hand torqued. Additionally, within the scope of our study, using a torque driver to tighten the screws with the recommended force prevented this loosening from reoccurring in all cases. (Implant Dent 2004;13:245–250)

Key Words: torque, wide diameter implant, abutment, screw

Screw loosening is considered to be a common problem with both screw-retained and cemented implant restorations.[1] Several complications may arise as a result of loose retaining or abutment screws. There can be granulation tissue between the loose abutment and the implant, leading to fistulae formation and infection of the soft tissue. In addition, loose screws are more apt to fracture under load, leading to long-term prosthesis complications.[2]

The literature to date does not present a consistent trend of reported screw loosening. Some investigators have found that as little as 2%[2-4] of all screws loosen, while others report a frequency of up to 40%.[5] Naert et al[4] reported that 5% of retaining gold screws loosened. Kallus and Bessing[5] reported that 40% of slotted gold screws, and 10% of internally hexed gold screws loosened. Overall, 26% of all gold retaining screws loosened and 4% of all abutment screws loosened. These authors examined screw loosening in full arch restorations only and speculated that a higher frequency of screw loosening was expected with single tooth restorations. Jemt et al[6] reported 26% loosening of gold retaining screws and 43% loosening of abutment screws over the first year on single tooth implants. Becker and Becker[7] reported 38% loosening of single implant restorations in the posterior maxilla and mandible.

The most likely cause of the majority of screw loosening is inadequate tightening of the screw.[8] Another important factor is the design and nature (design refers to shape, thread style, head design, and driver shape needed to insert, while nature refers to type of metal) of the screw itself. It was discovered that internally hexed screws could be tightened (even by hand) to a higher degree than slotted screws.[5] When a screw is tightened, a tensile force (preload) is built up in the stem of the screw. This preload creates a contact between the abutment and implant. The closer the tightening force approaches the recommended force for any particular screw, the more stable the connection will be. Thus, the design of the head and body of the screw is significant and should allow a maximum of torque to be introduced in the stem of the screw. The design of the screw head, screw material and tightening force are all important parameters for screw joint stability. McGlumphy stated that the clamping load must be greater than the separating forces to keep screws tight.[8a] Therefore, it was recommended to maximize preload forces and minimize joint separating forces.

Other possible factors contributing to screw loosening include nonpassive frameworks,[9] cantilevered frameworks,

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Influence of length, diameter and position of the implant in its fracture incidence: A Systematic Review

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PMID: 31592306 PMCID: PMC6773918 DOI: 10.15171/joddd.2019.017

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Abstract

Background. Implant fractures can cause difficult problems for patients and dentists. This systematic review aimed to determine the influence of some implant parameters on the occurrence of their fracture and to determine the incidence of fractures reported in recent years. ***Methods.*** A search was conducted in Pubmed database, from which 12 studies published in the last 12 years were selected. ***Results.*** This review reported a 2% incidence of implant fracture. Most implants had been in function between 3 and 4 years until fracture. The studies did not provide necessary information to establish a relationship between the different parameters of implants and the incidence of fractures. ***Conclusion.*** Thus, the indication of type, diameter and length of an implant and the bone quality in the region receiving it should be studied and accurately examined for each individual case in order to avoid future failures.

Keywords: Dental implants; dental restoration failure; mouth rehabilitation; periprosthetic fractures..

Effects of implant diameter, insertion depth, and loading angle on stress/strain fields in implant/jawbone systems: finite element analysis

Lihe Qian [1], Mitsugu Todo, Yasuyuki Matsushita, Kiyoshi Koyano

Affiliations + expand

PMID: 19865628

Abstract

Purpose: To investigate the interactions of implant diameter, insertion depth, and loading angle on stress/strain fields in a three-dimensional finite element implant/jawbone system and to determine the influence of the loading angle on stress/strain fields while varying the implant diameter and insertion depth.

Materials and methods: Four finite element models were created, which corresponded to two implant diameters and two insertion depths. The jawbone was composed of cortical and cancellous bone and modeled as a linearly elastic medium; the implant had a detailed screw structure and was modeled as an elastic-plastic medium. Static loading was applied to the coronal surface of the implant with a maximum load of 200 N for all the models. Loading directions were varied, with buccolingually applied loading angles ranging from 0 to 85 degrees.

Results: Increases in the angle of force application caused not only increased maximum stress/strain values but worsened stress/strain distribution patterns in the bone and implant. The maximum stress in the bone always occurred at the upper edge of the cortical bone on the lingual side adjacent to the implant. The use of a larger-diameter implant or an increased insertion depth significantly reduced the maximum stress/strain values, improved the stress/strain distribution patterns and, in particular, decreased the stress/strain sensitivity to loading angle.

Conclusions: A narrow-diameter implant, when inserted into jawbone with a shallow insertion depth and loaded with an oblique loading angle, is most unfavorable for stress distribution in both bone and implant. An optimized design of the neck region of an implant, in combination with a carefully controlled implant insertion depth that sets the threads of the implant neck well below the upper edge of the cortical bone, should be especially effective in improving the biomechanical environment for the maintenance of bone in implant/bone systems.

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Analysis of implant-failure predictors in the posterior maxilla: a retrospective study of 1395 implants

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Abstract

The aim of this study was to analyze predictors for dental implant failure in the posterior maxilla. A database was created to include patients being treated with dental implants posterior to the maxillary cuspids. Independent variables thought to be predictive of potential implant failure included (1) sinus elevation, (2) implant length, (3) implant diameter, (4) indication, (5) implant region, (6) timepoint of implant placement, (7) one-vs. two-stage augmentation, and (8) healing mode. Cox regression analysis was used to evaluate the influence of predictors 1-3 on implant failure as dependent variable. The predictors 4-9 were analyzed strictly descriptively. The final database included 592 patients with 1395 implants. The overall 1- and 5-year implant survival rates were 94.8% and 88.6%, respectively. The survival rates for sinus elevation vs. placement into native bone were 94.4% and 95.4%, respectively ($p = 0.33$). The survival rates for the short (<10 mm), the middle (10-13 mm) and the long implants (>13 mm) were 100%, 89% and 76.8%, respectively (middle-vs. long implants $p = 0.62$). The implant survival rates for the small- (<3.6 mm), the middle- (3.6-4.5 mm) and the wide diameter implants (>4.5 mm) were 92.5%, 87.9% and 89.6%, respectively ($p = 0.0425$). None of the parameters evaluated were identified as predictor of implant failure in the posterior maxilla.

Keywords: Implant; Implant diameter; Implant failure predictor; Implant length; Posterior maxilla; Sinus elevation.

Mechanics of the Implant-Abutment Connection: An 8-Degree Taper Compared to a Butt Joint Connection

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This paper presents a comparison between the 8-degree Morse Taper and the butt joint as connections between an implant and an abutment. Three-dimensional, non-linear finite element models were created to compare the 2 connection principles under equal conditions. The loading configuration was thereby modeled according to a test setup actually used for the dynamic long-term testing of dental implants as required for regulatory purposes. The results give insight into the mechanics involved in each type of connection and are compared to actual findings with the testing machine. The comparison indicates the superior mechanics of conical abutment connections and helps to explain their significantly better long-term stability in the clinical application. (INT J ORAL MAXILLOFAC IMPLANTS 2000;15:519–526)

Key words: *dental implants, finite element analysis, mechanical stress*

> J Adv Prosthodont. 2018 Apr;10(2):155-162. doi: 10.4047/jap.2018.10.2.155. Epub 2018 Apr 18.

Comparison of implant component fractures in external and internal type: A 12-year retrospective study

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Affiliations + expand

PMID: 29713437 PMCID: PMC5917108 DOI: 10.4047/jap.2018.10.2.155

Free PMC article

Abstract

Purpose: The aim of this study was to compare the fracture of implant component behavior of external and internal type of implants to suggest directions for successful implant treatment.

Materials and methods: Data were collected from the clinical records of all patients who received WARANTEC implants at Seoul National University Dental Hospital from February 2002 to January 2014 for 12 years. Total number of implants was 1,289 and an average of 3.2 implants was installed per patient. Information about abutment connection type, implant locations, platform sizes was collected with presence of implant component fractures and their managements. SPSS statistics software (version 24.0, IBM) was used for the statistical analysis.

Results: Overall fracture was significantly more frequent in internal type. The most frequently fractured component was abutment in internal type implants, and screw fracture occurred most frequently in external type. Analyzing by fractured components, screw fracture was the most frequent in the maxillary anterior region and the most abutment fracture occurred in the maxillary posterior region and screw fractures occurred more frequently in NP (narrow platform) and abutment fractures occurred more frequently in RP (regular platform).

Conclusion: In external type, screw fracture occurred most frequently, especially in the maxillary anterior region, and in internal type, abutment fracture occurred frequently in the posterior region. placement of an external type implant rather than an internal type is recommended for the posterior region where abutment fractures frequently occur.

Keywords: Abutment fracture; Fixture fracture; Implant fracture; Screw fracture.

Evolution of External and Internal Implant to Abutment Connection

Ninad Muley, DR Prithviraj, Vikas Gupta

ABSTRACT

A study of the implant to abutment connection is of paramount importance as it is the primary determinant of the strength and stability of the implant supported restoration, which in turn determines the restoration's prosthetic stability. Traditionally, the Branemark's external hexagon has been widely used but its significant complications like abutment screw loosening, rotational misfit at implant-abutment interface and microbial penetration have led to modification of the external hexagon and the development of the internal implant-abutment connections. This review describes the various implant-abutment connections that have evolved overtime from the traditional external hexagon.

Keywords: Implant-abutment interface, External hexagon, Internal hexagon, Spline dental implants, Morse taper implants.

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INTRODUCTION

The roots of implant dentistry were laid way back in the 1980's in the United States of America in the Branemark's protocol. Since then, implant dentistry has continuously evolved from the original Branemark protocol to include varied techniques and applications.[1,2] This evolution has been possible because numerous investigators have documented the biological factors, surgical procedures and restorative principles that influence the outcome of implant restorations, thus widening the applications of implant dentistry from restoration of a single tooth to multiple missing teeth with predictable success.[3,4] The mechanical principles governing implant restorations have also been clearly defined and understood.[5,6] Improvement in restorative principles and better understanding of the perceived outcome of implant therapy has led to the development of the concept of restoration-driven implant dentistry.[7]

The original Branemark's protocol involves a two-stage surgical procedure and was designed to restore a completely edentulous mandibular arch.[8] The first step involved the placement of a titanium screw into viable bone and an undisturbed healing period of at least 3 months. The next step involved the exposure of the implant, attachment of a transmucosal element and the connection of the implant to the prosthetic component of the restoration. In this protocol, the implant-abutment interface was an external hexagon of 0.7 mm height. This external hex served the purpose of a torque transfer coupling device (fixture mount) during the initial placement of the implant into the bone and the subsequent connection of the transmucosal extension, which when used in series could effectively restore the completely edentulous arch. Although the external hex served the aforementioned purposes, it was not an effective antirotation device[9] and was not designed to withstand the forces directed on the crowns intraorally.[10] These properties are required when implants are used to restore partially edentulous arches or a single missing tooth. Thus, implant manufacturers had to compensate for this by changing the type of screw used (e.g. geometry, height, surface area), the precision of the fit over the hex, and the amount of torque used to secure the screws.[11-13]

Also, to overcome the inherent deficiencies of the original external hex, a variety of implant to abutment connections have evolved from it. The goals of new designs are to improve connection stability throughout the placement and function and simplify the armamentarium necessary for the clinician to complete the restoration. The implant-abutment interface determines joint strength, stability, and lateral and rotational stability of the joint.[14] Thus, the joint stability is one of the most important parameters for the success of implant therapy.

A number of implant-abutment connection designs are commercially available and the clinician is often perplexed as to which implant system and which connection design to choose. This literature review analyses the evolution of various implant-abutment connections from the traditional external hexagon implant to the morse taper implants and aims to provide the clinician with an overview of the various commercially available implant-abutment connections.

SEARCH STRATEGY

An electronic search was performed of articles on Medline from September 1983 to June 2012. Keywords, such as implant abutment interface, external hexagon implants, internal hexagon implants, morse taper implants, were used alone or in combination to search the database. The option of 'related articles' was also utilized. Finally, a search was performed of the references of review articles and the most relevant papers.

In vitro study of the influence of the type of connection on the fracture load of zirconia abutments with internal and external implant-abutment connections

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PMID: 19865625

Abstract

Purpose: To determine whether zirconia abutments with an internal connection exhibit similar fracture load as zirconia abutments with an external connection.

Materials and methods: The following zirconia abutments were divided into four groups of 20 each: StraumannCARES abutments on Straumann implants (group A), Procera abutments on Branemark implants (group B), Procera abutments on NobelReplace implants (group C), and Zirabut SynOcta prototype abutments on Straumann implants (group D). The abutments were fixed on their respective implants either internally via a secondary abutment (A) or a metallic coupling (C) (two-piece) or directly externally (B) and internally (D) (one-piece). In each group, 10 abutments were left unrestored (A1 to D1). Ten received glass-ceramic crowns (A2 to D2). Static loading was performed according to the ISO norm 14801 until failure. The bending moment was calculated for comparison of the groups and subjected to statistical analysis (Student t test).

Results: The mean bending moments of the unrestored abutments were 371.5 +/- 142.3 Ncm (A1), 276.5 +/- 47.6 Ncm (B1), 434.9 +/- 124.8 Ncm (C1), and 182.5 +/- 136.5 Ncm (D1). Two-piece internally connected abutments exhibited higher bending moments than one-piece internally (C1 versus D1 $P = .003$, A1 versus D1 $P = .03$) or externally (C1 versus B1 $P = .004$) connected abutments. The groups with restorations did not show different bending moments than those without restorations. The mean bending moments of the restored abutments were 283.3 +/- 44.8 Ncm (A2), 291.5 +/- 31.7 Ncm (B2), 351.5 +/- 58 Ncm (C2), and 184.3 +/- 77.7 Ncm (D2). Group C2 exhibited the highest bending moment ($P < .05$). Internally connected one-piece abutments (D2) were weaker than all other groups (D2 versus A2 $P = .002$; D2 versus B2 $P = .001$; D2 versus C2 $P = .0003$).

Implant-abutment interface design affects fatigue and fracture strength of implants

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PMID: 19040443 DOI: 10.1111/j.1600-0501.2008.01581.x

Abstract

Objectives: Failures of implant-abutment connections are relatively frequent clinical problems. The aim of this study was to evaluate the influence of long-term dynamic loading on the fracture strength of different implant-abutment connections.

Material and methods: Six implant systems were tested: two systems with external connections (Brånemark, Compress) and four systems with internal connections (Frialit-2, Replace-Select, Camlog, Screw-Vent). Fracture strength was tested in two subgroups for each system: one subgroup with (dyn) and the other without prior dynamic loading (contr). Each subgroup consisted of eight specimens with standard implant-abutment combinations for single molar crowns. Dynamic loading was performed in a two-axis chewing simulator with 1,200,000 load cycles at 120 N.

Results: Median fracture strengths in Newton (N) and 25th and 75th percentiles [in brackets] were: Brånemark: dyn=729 [0;802]/contr=782 [771;811], Frialit-2: dyn=0 [0;611]/contr=887 [798;941], Replace-Select: dyn=1439 [1403;1465]/contr=1542 [1466;1623], Camlog: dyn=1482 [1394;1544]/contr=1467 [1394;1598], Screw-Vent: dyn=0 [0;526]/contr=780 [762;847] and Compress: dyn=818[0;917]/contr=1008 [983;1028]. In some dyn subgroups, failures of the implant-abutment connection occurred already during dynamic loading: three specimens of the Brånemark and Compress groups and six specimens of the Screw-Vent and the Frialit-2 groups failed during dynamic loading. Statistically significant differences (P< or =0.05) in fracture strength could be found between groups with different connection designs.

Conclusion: Implant systems with long internal tube-in-tube connections and cam-slot fixation showed advantages with regard to longevity and fracture strength compared with systems with shorter internal or external connection designs.

Comparative Study > J Oral Rehabil. 2006 Jan;33(1):75-8.
doi: 10.1111/j.1365-2842.2006.01545.x.

In vitro differences of stress concentrations for internal and external hex implant-abutment connections: a short communication

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PMID: 16409521 DOI: 10.1111/j.1365-2842.2006.01545.x

Abstract

The aim of this study was to clarify the difference in the stress distribution patterns between implants with external-hex or internal-hex connection systems using in vitro models. Three 13 mm fixtures with external-hex and internal-hex connections were installed into an acrylic bone analogue. One piece abutments of 7 mm height was connected. Strain gauges were attached to the abutment surface, and the cervical and fixture tip areas of the bone analogue surface. Vertical and horizontal load applied was 30 N. Data were normalized for each model by obtaining values relative to the sum of the three values. Almost the same force distribution pattern was found under vertical load in both systems. Fixtures with external-hex showed an increase in strain at the cervical area under horizontal load, while in internal-hex fixtures the strain was at the fixture tip area. Within limitations of our model study, it was suggested that fixtures with internal-hex showed widely spread force distribution down to the fixture tip compared with external hex ones.

> Int J Oral Maxillofac Implants. Jan-Feb 2005;20(1):69-76.

An assessment of crown-to-root ratios with short sintered porous-surfaced implants supporting prostheses in partially edentulous patients

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Abstract

Purpose: Implant length, implant surface area, and crown-to-root (c/r) ratio and their relationship to crestal bone levels were analyzed in 2 groups of partially edentulous patients treated with sintered porous-surfaced dental implants.

Materials and methods: One hundred ninety-nine implants were used to restore 74 partially edentulous patients with fixed prostheses. Implants were categorized according to their length ("short" versus "long") and estimated surface area ("small" versus "large"). "Short" implants had lengths of 5 or 7 mm, while "long" implants were either 9 or 12 mm in length. "Small" implants had estimated surface areas of < or = 600 mm2, while "large" implants had estimated surface areas > 600 mm2. Other data collected included c/r ratio (measured on articulated diagnostic casts), whether or not the implants were splinted, and standardized sequential radiographs.

Results: The mean c/r ratio was 1.5 (SD = 0.4; range 0.8 to 3.0), with 78.9% of the implants having a c/r ratio between 1.1 and 2.0. Neither c/r ratio nor estimated implant surface area (small or large) affected steady-state crestal bone levels. However, implant length and whether the implants were splinted did appear to affect bone levels. Long implants had greater crestal bone loss (0.2 mm more) than short implants; splinted implants showed greater crestal bone loss (0.2 mm more) than nonsplinted ones. These differences were statistically significant.

Discussion and conclusions: Sintered porous-surfaced implants performed well in short lengths (7 mm or less) in this series of partially edentulous patients. The data suggested that long implants and/or splinting can result in greater crestal bone loss; longer implants and splinted implants appeared to favor greater crestal bone loss in this investigation. These conclusions are, of course, specific to the implants used and would not be relevant to other implant types.

> Clin Implant Dent Relat Res. 2015 Aug;17(4):724-31. doi: 10.1111/cid.12175. Epub 2013 Nov 17.

Effect of Crown to Implant Ratio and Anatomical Crown Length on Clinical Conditions in a Single Implant: A Retrospective Cohort Study

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PMID: 24238214 DOI: 10.1111/cid.12175

Abstract

Purpose: The aim of this retrospective cohort study was to evaluate the long-term influence of the crown-to-implant (C/I) ratio and anatomical crown length on clinical conditions around Astra single dental implants placed in the premolar and molar regions.

Materials and methods: Seventy-six subjects were selected from patients who had been treated with single Astra implants for replacement of missing premolars and molars. The peri-implant marginal bone level change was assessed 1 year after functional loading and 6 years after functional loading. To predict the peri-implant marginal bone level change using clinical and radiographic data, a multiple linear regression model was applied. The Wilcoxon rank sum test was used to analyze difference median in technical complications.

Results: The C/I ratio and anatomical crown length were not associated with peri-implant marginal bone loss or changes in the bone level at 6 years ($p = .48$, $p = .31$). However, the modified plaque index, modified sulcus bleeding index, and smoking status influenced the peri-implant marginal bone loss ($p < .05$, $r(2) = 0.54$). In addition, the patient with technical complication group did show significantly increased anatomical crown length ($p < .05$) CONCLUSIONS: The higher C/I ratio and anatomical crown length did not increase the risk of peri-implant marginal bone loss during 6 years of functional loading. In addition, higher anatomical crown lengths are associated with higher technical complications.

Keywords: crown-to-implant ratio; marginal bone loss; single implant.

> J Oral Rehabil. 2016 Feb;43(2):127-35. doi: 10.1111/joor.12342. Epub 2015 Aug 30.

Does crown/implant ratio influence the survival and marginal bone level of short single implants in the mandibular molar? A preliminary investigation consisting of 12 patients

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PMID: 26333185 DOI: 10.1111/joor.12342

Abstract

Crown/implant (C/I) ratio has been proven to not affect the survival of the implants; however, it is also a fact that no evidence exists with regard to the use of single short implants in the mandibular molar. The aim of this study was to determine whether the crown/implant ratios of single implant-supported fixed restorations on implants of 6-8 mm in the mandibular molar have an impact on the implant survival and marginal bone maintenance. Twelve short dental implants (6-8 mm) were installed and restored with single crowns, loaded after 3 months of healing. The restorations were divided according to crown-to-implant ratio into two groups: Group 1: C/I < 2.0 and Group 2: C/I $\geqq 2.0$. Alveolar bone loss was measured using CBCT scan, taken at the implant placement and after 12 months follow-up from loading. Reduced implant/crown ratio shown no statistic significant differences on implant survival and the alveolar bone level compared with recommended implant/crown ratio. Within the limitation of this study, it can be concluded that reduced C/I ratio could be used as a substitute for recommended C/I ratio in severely mandibular atrophic residual alveolar ridges.

Keywords: bone resorption; dental implants; mandible; prostheses and implants; single tooth; treatment outcome.

> Clin Implant Dent Relat Res. 2015 Jan;17 Suppl 1:e183-91. doi: 10.1111/cid.12153.
Epub 2013 Sep 11.

Influence of prosthetic parameters on peri-implant bone resorption in the first year of loading: a multi-factorial analysis

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PMID: 24020722 DOI: 10.1111/cid.12153

Abstract

Background: The first year of prosthetic loading is crucial to peri-implant bone levels; however, contributing factors are yet barely understood.

Purpose: The purpose of the study is to investigate the influence of patient-, implant-, and prosthetic-related parameters on marginal bone resorption in partially edentulous patients within the first year of prosthetic loading.

Materials and methods: This retrospective multifactorial analysis involved the following influencing factors: patient gender and age, implant diameter, implant location and neck design, insertion torque, insertion depth, splinted versus single-tooth restorations, crown height space, and crown-to-implant ratio.

Results: Mean peri-implant bone resorption around 200 dental implants was 0.98 ± 0.76 mm and significantly correlated to higher implant insertion depth ($p < .001$), whereas no association to prosthetic parameters could be observed.

Conclusions: Within the limits of the present analysis, it can be concluded that apical implant positioning may constitute a relevant determinant of early peri-implant bone resorption.

Keywords: clinical study; crestal bone resorption; implant stability; implant surface; implant-supported crown; osseointegration; radiographs; tapered implants.

Randomized Controlled Trial > Int J Oral Maxillofac Implants. Sep-Oct 2011;26(5):1102-7.

Long-term outcome of cemented versus screw-retained implant-supported partial restorations

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Abstract

Purpose: The present study was designed to compare the long-term outcome and complications of cemented versus screw-retained implant restorations in partially edentulous patients.

Materials and methods: Consecutive patients with bilateral partial posterior edentulism comprised the study group. Implants were placed, and cemented or screw-retained restorations were randomly assigned to the patients in a split-mouth design. Follow-up (up to 15 years) examinations were performed every 6 months in the first year and every 12 months in subsequent years. The following parameters were evaluated and recorded at each recall appointment: ceramic fracture, abutment screw loosening, metal frame fracture, Gingival Index, and marginal bone loss.

Results: Thirty-eight patients were treated with 221 implants to support partial prostheses. No implants during the follow-up period (mean follow-up, 66 ± 47 months for screw-retained restorations [range, 18 to 180 months] and 61 ± 40 months for cemented restorations [range, 18 to 159 months]). Ceramic fracture occurred significantly more frequently ($P < .001$) in screw-retained (38% ± 0.3%) than in cemented (4% ± 0.1%) restorations. Abutment screw loosening occurred statistically significantly more often ($P = .001$) in screw-retained (32% ± 0.3%) than in cement-retained (9% ± 0.2%) restorations. There were no metal frame fractures in either type of restoration. The mean Gingival Index scores were statistically significantly higher ($P < .001$) for screw-retained (0.48 ± 0.5) than for cemented (0.09 ± 0.3) restorations. The mean marginal bone loss was statistically significantly higher ($P < .001$) for screw-retained (1.4 ± 0.6 mm) than for cemented (0.69 ± 0.5 mm) restorations.

Conclusion: The long-term outcome of cemented implant-supported restorations was superior to that of screw-retained restorations, both clinically and biologically.

Clinical performance of screw- versus cement-retained fixed implant-supported reconstructions--a systematic review

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PMID: 24660192 DOI: 10.11607/jomi.2014suppl.g2.1

Abstract

Purpose: To assess the survival outcomes and reported complications of screw- and cement-retained fixed reconstructions supported on dental implants.

Materials and methods: A Medline (PubMed), Embase, and Cochrane electronic database search from 2000 to September 2012 using MeSH and free-text terms was conducted. Selected inclusion and exclusion criteria guided the search. All studies were first reviewed by abstract and subsequently by full-text reading by two examiners independently. Data were extracted by two examiners and statistically analyzed using a random effects Poisson regression.

Results: From 4,324 abstracts, 321 full-text articles were reviewed. Seventy-three articles were found to qualify for inclusion. Five-year survival rates of 96.03% (95% confidence interval [CI]: 93.85% to 97.43%) and 95.55% (95% CI: 92.96% to 97.19%) were calculated for cemented and screw-retained reconstructions, respectively ($P = .69$). Comparison of cement and screw retention showed no difference when grouped as single crowns (I-SC) ($P = .10$) or fixed partial dentures (I-FDP) ($P = .49$). The 5-year survival rate for screw-retained full-arch reconstructions was 96.71% (95% CI: 93.66% to 98.31). All-ceramic reconstruction material exhibited a significantly higher failure rate than porcelain-fused-to-metal (PFM) in cemented reconstructions ($P = .01$) but not when comparing screw-retained reconstructions ($P = .66$). Technical and biologic complications demonstrating a statistically significant difference included loss of retention ($P \le .01$), abutment loosening ($P \le .01$), porcelain fracture and/or chipping ($P = .02$), presence of fistula/suppuration ($P \le .001$), total technical events ($P = .03$), and total biologic events ($P = .02$).

Conclusions: Although no statistical difference was found between cement- and screw-retained reconstructions for survival or failure rates, screw-retained reconstructions exhibited fewer technical and biologic complications overall. There were no statistically significant differences between the failure rates of the different reconstruction types (I-SCs, I-FDPs, full-arch I-FDPs) or abutment materials (titanium, gold, ceramic). The failure rate of cemented reconstructions was not influenced by the choice of a specific cement, though cement type did influence loss of retention.

Comparative Study > Int J Prosthodont. May-Jun 2016;29(3):265-70. doi: 10.11607/ijp.4341.

Comparison of Different Impression Techniques When Using the All-on-Four Implant Treatment Protocol

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PMID: 27148987 DOI: 10.11607/ijp.4341

Abstract

Purpose: The aim of this in vitro study was to compare the accuracy of two different impression techniques for the All-on-Four implant therapy protocol.

Materials and methods: An acrylic resin analog for an edentulous maxilla with four internal connection implants (Replace Select, Nobel Biocare) was fabricated according to the All-on-Four protocol. A total of 40 impressions were made with different techniques (open and closed tray) at abutment and implant levels and poured in type IV dental stone. A coordinate measuring machine was used to record the x, y, and z coordinates and angular displacement. The measurements were compared with those obtained from the reference model. Data were analyzed with analysis of variance and t test at $\alpha = .05$.

Results: There was less linear and rotational displacement for the open-tray technique when compared with the closed-tray technique ($P = .02$ and $P < .001$, respectively). Impressions made at abutment level produced fewer linear and rotational displacements when compared with implant level impressions using the open-tray technique for straight and angulated implants ($P = .04$ and $P < .001$, respectively). However, less rotational dislocation was observed for impressions made with the closed-tray technique when compared with the open-tray technique at implant level ($P < .001$).

Conclusion: Choice of impression technique affected the accuracy of impressions, and less displacement was observed with the open-tray method. Abutment-level impressions with an open-tray technique were more accurate, while implant-level impressions were more accurate when a closed-tray technique was used.

Comparative Study > J Oral Implantol. 2014 Dec;40(6):633-9.
doi: 10.1563/AAID-JOI-D-12-00198.

Effect of splinting in accuracy of two implant impression techniques

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PMID: 25506658 DOI: 10.1563/AAID-JOI-D-12-00198

Abstract

Because there is no consensus in the literature about the need for a splint between copings, the aim of this study was to evaluate, in vitro, the accuracy of 2 impression techniques for implant-supported prostheses. A master cast was fabricated with four parallel implant abutment analogs and a passive framework. Two groups with 5 casts each were formed: Group 1 (squared impression copings with no splint: S) and Group 2 (splinted squared impression copings, using metal drill burs and Pattern resin: SS). The impression material used was polyvinyl siloxane with open trays for standard preparation of the casts. For each cast, the framework was positioned, and a titanium screw was tightened with 10 N·cm torque in analog A, after which measurements of the abutment-framework interface gaps were performed at analogs C and D. This process was repeated for analog D. These measurements were analyzed using software. A one-way analysis of variance (ANOVA) with a confidence interval of 95% was used to analyze the data. Significant differences were detected between S and SS in relation to the master cast ($P \leq 0.05$). The median values of the abutment-framework interface gaps were as follows: master cast: 39.64 µm; squared impression copings with no splint: 205.86 µm; splinted squared impression copings: 99.19 µm. Under the limitations of this study, the technique presented for Group 2 produces better results compared with the technique used for Group 1.

Keywords: dental implants; dental material; impression materials; impression techniques; splinting material.

> Int J Oral Maxillofac Implants. Sep-Oct 2007;22(5):761-8.

Evaluation of the accuracy of implant-level impression techniques for internal-connection implant prostheses in parallel and divergent models

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Affiliations + expand

PMID: 17974110

Abstract

Purpose: This study evaluated the accuracy of 2 implant-level impression techniques (direct nonsplinted and splinted) for the fabrication of multi-unit internal-connection implant restorations in 2 simulated clinical settings (parallel and divergent) using a laboratory model.

Materials and methods: A dental stone master model was fabricated with 2 pairs of implant replicas. One pair simulated a parallel clinical condition and the other an 8-degree-divergent condition. Ten stone casts were made from vinyl polysiloxane impressions of the master model for each impression technique. Half of the samples were created by a direct nonsplinted technique (square impression copings, custom tray), and the other half were made by a direct splinted technique (square impression copings splinted with autopolymerizing acrylic resin, custom tray). Four strain gauges were fixed on each metal framework to measure the degree of framework deformation for each stone cast in half-Wheatstone-bridge formations. Deformation readings were made twice in 4 directions (anterior, posterior, superior, and inferior). Deformation data were analyzed using repeated-measures analysis of variance at a .05 level of significance.

Results: No significant difference in deformation was found between the direct nonsplinted and splinted samples in either simulated clinical condition ($P > .05$). No significant difference in deformation was found between the techniques regardless of condition ($P > .05$).

Conclusions: Within the limitations of this study, using a 2-implant model, the accuracy of implant-level impressions for internal-connection implant restorations was similar for the direct nonsplinted and splinted techniques in settings with divergence up to 8 degrees.

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Accuracy of angulated implant position transfer by two types of impression trays using splinted open tray technique

Abstract

Background and Objectives: Accurate impression taking is a prerequisite for achieving passive fit between the implant and superstructure. This study sought to assess the accuracy of impressions taken from 15° and 25° angulated implants by two plastic and metal stock trays using the splinted open tray technique. Materials and Methods: This in vitro experimental study was conducted on 20 gypsum casts. An acrylic model was fabricated with a first premolar to first premolar edentulous area and second premolar and first, second and third molar teeth present in both sides. Two implants were placed vertically at the site of lateral incisors. At the site of first premolars, one implant with 15° angulation and another one with 25° angulation relative to the midline were inserted. Ten plastic and 10 metal stock trays were used for open tray impression taking with addition silicon impression material at the site of copings. Casts were poured and coded. Measurements were made using coordinate measuring machine (CMM). The data were analyzed using t-test (for normally distributed data) and non-parametric tests (for non-normally distributed data).

Results: The A1 distance was 7.253±0.053mm in plastic and 7.249±0.42mm in metal tray group. These values were 9.807±0.026mm and 9.802±0.009mm, respectively for A2, 34.483±0.132 and 34.462±0.112, respectively for A3, 28.210±0.1332 and 28.193±0.011, respectively for A4 and 52.709±0.032 and 52.717±0.041, respectively for A5. These differences were not statistically significant (P>0.05).

Conclusion: Both plastic and metal stock trays are accurate for position transfer of parallel and angulated implants in splinted open tray technique.

Keywords: dental implants, splinted open tray technique, metal and plastic stock trays, impression accuracy

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The effect of impression technique and implant angulation on the impression accuracy of external- and internal-connection implants

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Affiliations + expand
PMID: 23189292

Erratum in

Int J Oral Maxillofac Implants. 2013 Jan-Feb;28(1):43. Kafantaris, Nikolaos [added]

Abstract

Purpose: The purpose of this in vitro study was to investigate the effect of impression technique and implant angulation on the impression accuracy of external- and internal-connection implants using a novel experimental device.

Materials and methods: An experimental device was designed and fabricated to make in vitro impressions by means of open- and closed-tray techniques. Impressions of eight implants with two different connections (four external-hex and four internal-hex) at three angulations (0, 15, and 25 degrees) were made using a medium-consistency polyether material. Evaluation of implant impression accuracy was carried out by directly measuring the difference in coordinate values between the implant body/impression coping positioned on the base and the impression coping/laboratory analog positioned in the impression using a touch-probe coordinate measuring machine. Experimental data were analyzed by two-way analysis of variance. The significance level of all hypothesis testing procedures was set at $P<.05$.

Results: The results showed that: (1) for implants with external connections, impression accuracy is not significantly affected by the impression technique, implant angulation, or their interaction; and (2) for implants with internal connections, impression accuracy is significantly affected only by implant angulation: Impression inaccuracy was greater at the 25-degree implant angulation.

Conclusions: Within the limitations of this in vitro study, the open- and closed-tray techniques had no effect on the accuracy of multiple implant impressions. The interaction between impression technique and implant angulation was also not significant. However, implant angulation significantly

Effects of implant angulation, impression material, and variation in arch curvature width on implant transfer model accuracy

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Abstract

Purpose: The effects of implant angulation, impression material, and variation in width of the arch curvature on transfer models were evaluated.

Materials and methods: Three edentulous maxillary epoxy resin models were fabricated, and six internal-connection implant analogs were placed in different locations and different angulations in each model. In the first model, implants were positioned in the canine, first premolar, and first molar regions, and all analogs were positioned parallel to each other and perpendicular to the horizontal crestal plane (parallel model). In the second model, analogs were positioned in same regions (canine, first premolar, and first molar), but three of them were positioned with 10-degree buccal angulations (versus the horizontal crestal plane) (angular model). In the third model, analogs were inserted in the lateral incisor, canine, and second molar regions and parallel to each other (wide-arch model). Eighteen impressions of each model were made with each of the three materials--condensation silicone, polyvinyl siloxane, and polyether--and impressions were poured and kept at room temperature for 24 hours. They were then observed under a toolmaker's microscope, with epoxy resin models of each group used as references. Distance deformations between implants in each model in the x- and y-axes were recorded separately. Implant angulation deformations were recorded in the x-z plane. Statistical evaluations were performed with analysis of variance and the least significant difference post hoc test.

Results: Angular model measurements showed the greatest deformation values ($P < .05$). All impression materials showed deformation, and the polyether impression models showed statistically significantly less deformation in angular measurements ($P < .05$).

Conclusions: The models with implants placed parallel to each other exhibited greater accuracy than a model with implants placed at angles to each other.

> Int J Oral Maxillofac Implants. Jul-Aug 2013;28(4):989-95. doi: 10.11607/jomi.2938.

Effects of implant system, impression technique, and impression material on accuracy of the working cast

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Abstract

Purpose: This in vitro study aimed to identify the effects of the implant system, impression technique, and impression material on the transfer accuracy of implant impressions. The null hypothesis tested was that, in vitro and within the parameters of the experiment, the spatial relationship of a working cast to the placement of implants is not related to (1) the implant system, (2) the impression technique, or (3) the impression material.

Materials and methods: A steel maxilla was used as a reference model. Six implants of two different implant systems (Standard Plus, Straumann; Semados, Bego) were fixed in the reference model. The target variables were: three-dimensional (3D) shift in all directions, implant axis direction, and rotation. The target variables were assessed using a 3D coordinate measuring machine, and the respective deviations of the plaster models from the nominal values of the reference model were calculated. Two different impression techniques (reposition/pickup) and four impression materials (Aquasil Ultra, Flexitime, Impregum Penta, P2 Magnum 360) were investigated. In all, 80 implant impressions for each implant system were taken. Statistical analysis was performed using multivariate analysis of variance.

Results: The implant system significantly influenced the transfer accuracy for most spatial dimensions, including the overall 3D shift and implant axis direction. There was no significant difference between the two implant systems with regard to rotation. Multivariate analysis of variance showed a significant effect on transfer accuracy only for the implant system.

Conclusions: Within the limits of the present study, it can be concluded that the transfer accuracy of the intraoral implant position on the working cast is far more dependent on the implant system than on the selection of a specific impression technique or material.

Digital evaluation of the accuracy of impression techniques and materials in angulated implants

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Affiliations + expand

PMID: 25446736 DOI: 10.1016/j.jdent.2014.10.008

Abstract

Objectives: The aim of this study was to investigate the accuracy of 2 different impression techniques and 3 different impression materials in models simulating parallel and angulated implants.

Methods: Three master models simulating partial edentulous mandible with 2 implants at the sites of second premolars (parallel) and second molars with different angulations (parallel, 10° or 20° angulated) were fabricated. Two different impression techniques [splinted direct (D), indirect (I)] and 3 different monophase impression materials [polyether (PE), vinyl polysiloxane (VPS), vinyl polyether silicone (VPES)] were used for each master model and a total of 180 impressions were made (n=10). Master model and casts were scanned by a modified laser scanner and data were transferred to VRMesh software. Master model and duplicate cast scans were digitally aligned observing the superposition of anatomic markers. Angular and coronal deviations between master and duplicated copings were calculated and data were statistically analyzed.

Results: Mean angular and coronal deviations were in a range of 0.205-0.359° and 22.56-33.33µm, respectively. Statistical analysis revealed that the angulation of implant affected both coronal and angular deviations of the impression copings ($P<0.05$). According to statistical analyses, for parallel implants, the accuracy of impression materials and techniques were ranging as VPS-D=PE-D>VPS-I=PE-I>VPES-D>VPES-I from most accurate to the least. For 10° and 20° angulated implants the most accurate material and technique was VPS-D whereas the least accurate combination was VPES-I ($P<0.05$).

Conclusion: Angulation, impression technique and material were found to be effective on the accuracy of implant impressions.

Clinical significance: Clinicians may prefer VPS impression material and splinted direct technique for impressions of both parallel and up to 20° angulated implants.

Keywords: Implant angulation; Indirect technique; Polyether; Splinted direct technique; Vinyl polyether silicone; Vinyl polysiloxane.

Comparative evaluation of the effect of impression materials and trays on the accuracy of angulated implants impressions

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Abstract

Go to:

Background

Vinyl Polyether Siloxane is a newly introduced impression material and studies on that is scarce. Implant insertion in posterior mandible might be angulated due to anatomical considerations. The purpose of this study was to compare the dimensional and angular accuracy of impressions using full-arch versus sectional tray and Vinyl Polysiloxane versus Vinyl Polyether Siloxane in angulated implants.

Material and Methods

Four implants were placed in dental areas #19, #21, #28 and #30 of a Kennedy class I mandibular acrylic model with 30° lingual angulation. Twenty sectional and 20 full-arch open trays were made on the primary cast. Impressions were taken using Vinyl Polysiloxane and Vinyl Polyether Siloxane (n=10 in 4 groups); and were poured with type IV dental stone. The coordinate measuring machine was used to measure displacements in the X, Y and Z axes and rotational discrepancies of implants. The data were analyzed using SPSS 22 and two-way ANOVA.

Results

Type of tray had no significant effect on the dimensional and angular accuracy of impressions ($p > 0.05$). Type of impression material significantly affected linear displacement (Δr) ($P < 0.05$); but it did not significantly affect the rotational displacement ($P > 0.05$).

Conclusions

Vinyl Polysiloxane yielded more accurate impressions of angulated implants.

Key words: Dental implant, impression material, impression tray, vinyl polysiloxane, vinyl polyether silicone, coordinate measuring machine.

Evaluation of the accuracy of three techniques used for multiple implant abutment impressions

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Statement of problem. Movement of pick-up type impression copings inside the impression material during clinical and laboratory phases may cause inaccuracy in transferring the spatial position of implants from the oral cavity to the master cast. As a consequence, the laboratory technician may fabricate a restoration that requires corrective procedures.

Purpose. This in vitro study evaluated the accuracy of 3 different impression techniques using polyether impression material to obtain a master cast for the fabrication of a prosthesis that would fit passively on multiple implants.

Material and methods. A machined metal model with 6 implants and abutments and a corresponding, passively fitting, matching metal template were fabricated. A total of 45 medium-consistency polyether impressions (Impregum Penta) of this model were made with pick-up type square impression copings. Three groups of 15 each were made with different impression techniques: in group 1, nonmodified square impression copings were used; in group 2, square impression copings were used and joined together with autopolymerizing acrylic resin before the impression procedure; and in group 3, square impression copings previously airborne particle–abraded and coated with the manufacturer-recommended impression adhesive were used. The matching metal template, which had been passively fit to the metal model so that it encountered no visually perceptible resistance or rocking on the abutments, was used as the control for evaluation of the accuracy of passive fit. A single calibrated and blinded examiner visually evaluated each cast. Positional accuracy of the abutments was numerically assessed with an optical scanner at original magnification × 10, which provided measurements to within 2 μm of the variations of the casts with respect to the horizontal distances between the 2 most posterior abutments and the 2 most anterior abutments. Data were analyzed with a 1-way analysis of variance at α=.05, followed by the Student Newman-Keuls method (P=.05).

Results. Visual examination of the casts from group 1 revealed discrepancies between 1 or more abutments and the metal template. Visual analysis of the master casts from groups 2 and 3 revealed close alignment of the metal template on all 6 abutments. One-way analysis of variance analyzed the numerical data obtained with the optical scanner and revealed significant differences among the 3 impression techniques (P<.001). The Newman-Keuls procedure disclosed significant differences between the groups, with group 2 and 3 casts being significantly more accurate than group 1 casts (P=.05). The distance between abutments 1 and 6 compared to the standard metal model was 33.83 μm (SD ± 5.4) greater on group 2 casts, 31.72 μm (SD ± 4.6) greater on group 3 casts, and 78.16 μm (SD ± 22.14) greater on group 1 casts. Distances between the most anterior abutments were also greater than those recorded on the metal model. The distance was 31.42 μm (SD ± 7.6) greater on group 2 casts, 30.34 μm (SD ± 6.4) greater on group 3 casts, and 67.91 μm (SD ± 15.34) greater on group 1 casts.

Conclusion. Within the limitations of this study, improved accuracy of the master cast was achieved when the impression technique involved square impression copings joined together with autopolymerizing acrylic resin or square impression copings that had been airborne particle–abraded and adhesive-coated. (J Prosthet Dent 2003;89:186-92.)

CLINICAL IMPLICATIONS

The results of this study suggested that splinting implant impression copings with autopolymerizing resin or airborne particle abrading and coating the copings with impression adhesive before impression making should result in more accurate working casts. Because splinting with resin is not the preferred option when an immediate loading multiple implant impression is made, the airborne particle abrasion/impression adhesive technique should be considered.

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The influence of length of implant on primary stability: An *in vitro* study using resonance frequency analysis

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Abstract

Background

Primary stabilityis not sufficientin less contact area between the implant and bone, the healing process because will be disrupted due to micro-motions and fibrous tissue affects osseointegration.

Material and Methods

We implemented an in vitro experimental study of total 135 XiVE® implants were inserted in 22.5 bovine cow ribs with bone quality similar to a type IV human bone. Each rib end received a group of three different implant lengths, which were 8mm, 13mm and 15mm and had the same diameter 3.8mm. Immediately after the implant placement, its primary stability was measured using Osstell Mentor equipment. ANOVA Tukey's honest to test the significant difference were performed for data analysis between the resonance measures of the different lengths of implants. Statistical significance was assessed at a level $P < 0.05$.

Results

A total of 45 implants were inserted for each length at cortical bone level. A significant difference between the three groups in favor of implant with 15mm length group ($P = 0.000$).

Conclusions

Increasing dental implant length is considered to play a fundamental role in increasing dental implant primary stability, even in poor bone quality, through controlling the bone preparation process.

Key words: Dental implants, primary stability, resonance frequency analysis.

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Review > J Oral Rehabil. 2006 Feb;33(2):152-9. doi: 10.1111/j.1365-2842.2006.01542.x.

Dental implants in patients with bruxing habits

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Affiliations + expand

PMID: 16457676 DOI: 10.1111/j.1365-2842.2006.01542.x

Abstract

Bruxism (teeth grinding and clenching) is generally considered a contraindication for dental implants, although the evidence for this is usually based on clinical experience only. So far, studies to the possible cause-and-effect relationship between bruxism and implant failure do not yield consistent and specific outcomes. This is partly because of the large variation in the literature in terms of both the technical aspects and the biological aspects of the study material. Although there is still no proof for the suggestion that bruxism causes an overload of dental implants and of their suprastructures, a careful approach is recommended. There are a few practical guidelines as to minimize the chance of implant failure. Besides the recommendation to reduce or eliminate bruxism itself, these guidelines concern the number and dimensions of the implants, the design of the occlusion and articulation patterns, and the protection of the final result with a hard occlusal stabilization splint (night guard).

Is bruxism a risk factor for dental implants? A systematic review of the literature

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PMID: 23151302 DOI: 10.1111/cid.12015

Abstract

Purpose: To systematically review the literature on the role of bruxism as a risk factor for the different complications on dental implant-supported rehabilitations.

Material and methods: A systematic search in the National Library of Medicine's Medline Database was performed to identify all peer-reviewed papers in the English literature assessing the role of bruxism, as diagnosed with any other diagnostic approach (i.e., clinical assessment, questionnaires, interviews, polysomnography, and electromyography), as a risk factor for biological (i.e., implant failure, implant mobility, and marginal bone loss) or mechanical (i.e., complications or failures of either prefabricated components or laboratory-fabricated suprastructures) complications on dental implant-supported rehabilitations. The selected articles were reviewed according to a structured summary of the articles in relation to four main issues, viz., "P" - patients/problem/population, "I" - intervention, "C" - comparison, and "O" - outcome.

Results: A total of 21 papers were included in the review and split into those assessing biological complications (n = 14) and those reporting mechanical complications (n = 7). In general, the specificity of the literature for bruxism diagnosis and for the study of the bruxism's effects on dental implants was low. From a biological viewpoint, bruxism was not related with implant failures in six papers, while results from the remaining eight studies did not allow drawing conclusions. As for mechanical complications, four of the seven studies yielded a positive relationship with bruxism.

Conclusions: Bruxism is unlikely to be a risk factor for biological complications around dental implants, while there are some suggestions that it may be a risk factor for mechanical complications.

Keywords: biological complications; bruxism; dental implants; mechanical complications; risk factor.

> J Oral Rehabil. 2006 Nov;33(11):833-9. doi: 10.1111/j.1365-2842.2006.01638.x.

Prosthetic complications in fixed endosseous implant-borne reconstructions after an observations period of at least 40 months

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PMID: 17002743 DOI: 10.1111/j.1365-2842.2006.01638.x

Abstract

One hundred and seventy-two fixed reconstructions (317 prosthetic units), made on 283 ITI implants in 105 patients (age range 25-86 years) with a minimum follow-up period of 40 months, were taken into the study to analyse technical complication rate, complication type and costs for repair. The mean evaluation time was 62.5 +/- 25.3 months. Eighty were single crowns and 92 different types of fixed partial dentures (FPDs). In 45 cases the construction was screw retained and in 127 cases cemented with zinc phosphate cement or an acrylic-based cement. Complications occurred after a minimum period of 2 months and a maximum period of 100 months (mean: 35.9 +/- 21.4 months). Fifty-five prosthetic interventions were needed on 44 constructions (25%) of which 88% in the molar/premolar region. The lowest percentage of complications occurred in single crowns (25%), the highest in 3-4 unit FPDs (35%) and in FPDs with an extension (44%). Of the necessary clinical repair, 36% was recementing and 38% tightening the screws. Of all interventions, 14% were classified as minor (no treatment or <10 min chair time), 70% as moderate (>10 min but <60 min chair time) and 14% as major interventions (>60 min and additional costs for replacement of parts and/or laboratory). For seven patients the additional costs ranged from euro 28 to euro 840. Bruxing seemed to play a significant role in the frequency of complications. Longer constructions seemed to be more prone to complications. The relatively high occurrence of technical complications should be discussed with the patient before the start of the treatment.

Clinical Trial > Int J Oral Maxillofac Implants. Mar-Apr 2003;18(2):286-92.

Evaluation of sleep bruxism by polysomnographic analysis in patients with dental implants

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Affiliations + expand

PMID: 12705309

Abstract

Purpose: The aims of the present study were to use polysomnographic analysis to confirm sleep bruxism (SB) and to evaluate clinical findings of dental implant treatment in SB patients.

Materials and methods: The present study comprised the retrospective analysis of 368 patients with a total of 838 endosseous implants. Nineteen patients who experienced mechanical complications, such as implant or abutment fractures, loosened gold screws, or occlusal surface wear or damage, were selected for polysomnographic analysis to monitor sleep symptoms. Six patients in the study group were identified as having SB, and this was confirmed by polysomnographic analysis.

Results: The SB electromyographic episodes were at least 20% of the patients' maximum voluntary contractions while awake and were scored. Most of the bruxism episodes (80%) were seen in light sleep stages. Only 5% of bruxism episodes were detected during rapid-eye-movement sleep. Sleep stage recordings were similar in all individuals. Bruxism episodes did not cause arousals. Patients were unaware of their nocturnal parafunctional habits. Despite protection with night guards, all patients were reported to have continued bruxism.

Discussion: Since possible occlusal parafunctional habits may be evident in any stage of dental treatment, treatment outcome risks must be considered.

Conclusions: Polysomnographic study was evaluated as an effective, low-cost method to confirm occlusal parafunctional habits during sleep. Precautions against SB in patients having dental implant treatment have not been properly clarified. However, night guard protection appears to have some validity in patients having sleep bruxism.

Influence of prosthetic parameters on the survival and complication rates of short implants

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PMID: 16634499

Abstract

Purpose: Implants shorter than 10 mm can be a long-term solution for sites with limited bone height. The purpose of this study was to determine the influence of some prosthetic factors on the survival and complication rates.

Materials and methods: Two hundred sixty-two short machined-surface Brånemark System implants were consecutively placed in 109 patients and followed for a mean of 53 months. The prosthetic parameters were recorded, and the data were examined for relation to peri-implant bone loss and biologic or biomechanical complications.

Results: Relatively few crown-to-implant (C/I) ratios were < 1 or > 2 (16.2%). Occlusal table (OT) width ranged from 5.4 to 8.3 mm. Opposing dentition was most often natural teeth, a fixed prosthesis supported by natural teeth, or an implant-supported fixed restoration. Occlusion with a normal buccolingual maxillomandibular relationship was found in 72.7% of the cases. No significant difference in peri-implant bone loss was correlated with C/I ratio or OT. Neither cantilever length nor bruxism had a significant effect on peri-implant bone loss. Mean bone loss was 0.74 +/- .65 mm. The difference in the complication rate (15% overall) between the bruxer and the nonbruxer group was not statistically significant (P = .51). One implant was lost in a heavy bruxer after 7 years of function.

Discussion: Increased C/I and OT values do not seem to be a major risk factor in cases of favorable loading. In 67% of the cases, the mesiodistal length of the prosthesis was less than the corresponding natural tooth length, which may have contributed to better load distribution and more favorable results.

Conclusions: Short implants appear to be a longterm viable solution in sites with reduced bone height, even when the prosthetic parameters exceed the normal values, provided that force orientation and load distribution are favorable and parafunction is controlled.

Implant-supported single-tooth restorations: a 5-year prospective study

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PMID: 15882213 DOI: 10.1111/j.1600-051X.2005.00715.x

Abstract

Background: Comparatively few studies are available reporting at least 5 years of follow-up data of implant-supported single-tooth replacements.

Objective: To evaluate prospectively the 5-year outcome of implant-supported single-tooth prosthetic restorations.

Material and methods: Forty subjects (mean age 41 years), 23 males and 17 females, who required single-tooth prosthetic replacement for a missing tooth were recruited. A total of 45 self-tapping implants (Astra Tech ST-implants)--40 in the maxilla and five in the mandible--were installed in a two-stage procedure. Abutment connection was performed 3-6 months after implant installation. Clinical and radiographic examinations were performed at the completion of the prosthetic treatment and once a year during a 5-year follow-up period. The analysis of peri-implant bone level alteration was performed on subject and implant levels and by the use of analysis of variance and binary logistic regression.

Results: Three patients were lost during the 5 years of follow-up. One implant was lost after 2.5 years in function and another four implants could not be accounted for at the 5-year follow-up examination. The overall failure rate at 5 years was 2.6% (subject level) and 2.3% (implant level). The mean loss of marginal bone at the implants during the first year in function was 0.06 mm (SD 0.67) on the subject level and 0.02 mm (0.65) on the implant level. During the subsequent 4 years the annual change in peri-implant bone level amounted to -0.02 mm (0.22) on both subject and implant levels. Thus, the mean total bone level change over the 5-year interval was -0.14 mm (1.04) on subject level and -0.11 mm (1.00) on the implant level of analysis ($p>0.05$). The frequency of implants with a 5-year bone loss of > or =1 mm was 13%. Approximately 50% of the implants demonstrated no bone loss.

Conclusion: The present clinical trial on single-tooth replacements with the Astra Tech implant system demonstrated that the bone loss during the first year of function as well as annually thereafter was small.

> Clin Oral Implants Res. 2000 Oct;11(5):465-75. doi: 10.1034/j.1600-0501.2000.011005465.x.

Magnitude and distribution of occlusal forces on oral implants supporting fixed prostheses: an in vivo study

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PMID: 11168239 DOI: 10.1034/j.1600-0501.2000.011005465.x

Abstract

Since loading is increasingly believed to be a determining factor in the treatment outcome with oral implants, there is a need to expand the knowledge related to the biomechanics of oral implants. The aim of this study is to gain insight in the distribution and magnitude of occlusal forces on oral implants carrying fixed prostheses. This is done by in vivo quantification and qualification of these forces, which implies that not only the magnitude of the load but also its type (axial force or bending moment) will be registered. A total of 13 patients with an implant supported fixed full prosthesis were selected. Occlusal forces on the supporting implants were quantified and qualified during controlled load application of 50 N on several positions along the occlusal surface of the prostheses and during maximal biting in maximal occlusion by use of strain gauged abutments. The test was conducted when the prostheses were supported by all (5 or 6) implants and was repeated when the prostheses were supported by 4 and by 3 implants only. Despite considerable inter-individual variation, clear differences in implant loading between these test conditions were seen. Loading of the extension parts of the prostheses caused a hinging effect which induced considerable compressive forces on the implants closest to the place of load application and lower compressive or tensile forces on other implants. On average, higher forces were observed with a decreasing number of supporting implants. Bending moments were highest when 3 implants only were used.

The rehabilitation of completely edentulous maxillae with different degrees of resorption with four or more immediately loaded implants: a 5-year retrospective study and a new classification

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PMID: 22043467

Abstract

Purpose: To report the long-term outcome of immediately loaded implants in the rehabilitations of completely edentulous maxillae with different classifications. The secondary aim was to evaluate the influence of possible explanatory variables on the incidence of biological and mechanical complications.

Material and methods: In total, 221 patients were consecutively included and classified into four groups that allowed implant placement in a vertical position: Group 1 (bone available up to first molar), Group 2 (bone available up to second premolar), Group 3 (bone available up to first premolar) and Group 4 (bone available up to canine). Outcome measures were prosthesis and implant survival, and biological and mechanical complications.

Results: A total of 995 implants were placed. Eighteen patients (8% of the sample) dropped out of the study. After 5 years, three patients lost their prosthesis due to implant failures, giving a survival rate of 98.6%; 25 patients lost 41 implants, giving a survival rate of 88.7% (25/221) and an implant-specific survival rate of 95.8% (41/995). According to the edentulism classification, the patient-specific survival rate after 5 years was 78.6% for Group 1, 89.3% for Group 2, 92.4% for Group 3 and 91.7% for Group 4. In total, 129 biological complications occurred affecting 129 implants (13%) in 66 patients (30%). Smoking was identified as a risk factor for the incidence of biological complications with an OR of 3.03 (95% CI 2.03-4.56; $P < 0.0001$), while 'gender' (male; OR = 0.56; 95% CI 0.37-0.85; $P = 0.007$) was a factor that had a protective effect. A total of 170 mechanical complications occurred, affecting 170 implants (17%) in 71 patients (38%). Bruxism was identified as a risk factor for the incidence of mechanical complications with an OR of 60.95 (95% CI 21.40-173.54; $P < 0.0001$), while a Group 2 edentulism classification had a protective effect for the incidence of mechanical complications with an OR of 0.22 (95% CI 0.07-0.71; $P = 0.011$).

Does Bruxism Contribute to Dental Implant Failure? A Systematic Review and Meta-Analysis

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Affiliations + expand

PMID: 25726844 DOI: 10.1111/cid.12300

Abstract

Background: Bruxism was usually considered as a contraindication for oral implanting. The causal relationship between bruxism and dental implant failure was remained controversial in existing literatures.

Purpose: This meta-analysis was performed to investigate the relationship between them.

Materials and methods: This review conducted an electronic systematic literature search in MEDLINE (PubMed) and EmBase in November 2013 without time and language restrictions. Meanwhile, a hand searching for all the relevant references of included studies was also conducted Study information extraction and methodological quality assessments were accomplished by two reviewers independently. A discussion ensued if any disagreement occurred, and unresolved issues were solved by consulting a third reviewer. Methodological quality was assessed by using the Newcastle-Ottawa Scale tool. Odds ratio (OR) with 95% confidence interval (CI) was pooled to estimate the relative effect of bruxism on dental implant failures. Fixed effects model was used initially; if the heterogeneity was high, random effects model was chosen for meta-analysis. Statistical analyses were carried out by using Review Manager 5.1.

Results: In this meta-analysis review, extracted data were classified into two groups based on different units. Units were based on the number of prostheses (group A) and the number of patients (group B). In group A, the total pooled OR of bruxers versus nonbruxers for all subgroups was 4.72 (95% CI: 2.66-8.36, p = .07). In group B, the total pooled OR of bruxers versus nonbruxers for all subgroups was 3.83 (95% CI: 2.12-6.94, p = .22).

Conclusions: This meta-analysis was performed to evaluate the relationship between bruxism and dental implant failure. In contrast to nonbruxers, prostheses in bruxers had a higher failure rate. It suggests that bruxism is a contributing factor of causing the occurrence of dental implant technical/biological complications and plays a role in dental implant failure.

Keywords: bruxism; complication; dental implant; implant failure; teeth grinding.