TRABAJO DE FIN DE GRADO

Grado en Odontología

INTERRELACIÓN ORTODONCIA

PERIODONCIA

Madrid, curso 2020/2021

Número identificativo 96

Resumen:

Introducción: En este trabajo de revisión bibliográfica se han abordado los problemas relacionados con la periodoncia en diferentes niveles que pueden mejorar o empeorar con la ortodoncia como las troneras gingivales abiertas, también se han desarrollado problemas derivados de la ortodoncia que requieren intervención periodontal como la gingivitis producida por los aparatos, la recesión gingival o la pérdida del aparato de sostén del diente. Se han mencionado los problemas ortodóncicos más comunes en la enfermedad periodontal, así como los tratamientos que la mejoran a nivel de ortodoncia. Por último, se ha relacionado la ortodoncia y los implantes, ante la situación de la pérdida de un diente no restaurable, antes de la extracción se puede realizar la extrusión con ortodoncia para aumentar el nivel de hueso.

Objetivos: Se ha comparado la salud gingival entre pacientes portadores de ortodoncia fija y alineadores transparentes removibles, estudiado si la carga bacteriana en boca aumenta en pacientes con ortodoncia y analizado si los aparatos de ortodoncia producen halitosis.

Metodología: Se ha realizado una búsqueda bibliográfica en diferentes bases de datos como *Medline Complete* o *PubMed.*

Discusión: Se han comparado diferentes artículos para analizar las diferencias en la salud gingival, tanto a nivel de los índices periodontales, como a nivel bacteriano entre portadores de varios tipos de aparatos como son la ortodoncia fija bucal y lingual o alineadores invisibles. También entre *brackets* autoligados y convencionales.

Conclusiones: Los pacientes con alineadores transparentes removibles, presentaron mejores condiciones de salud gingival que los usuarios de ortodoncia fija; especialmente significativo si comparamos con ortodoncia fija lingual. No hay diferencias significativas entre el uso de *brackets* autoligados y *brackets* convencionales. Las bacterias asociadas a los aparatos de ortodoncia no tuvieron prácticamente relevancia en la halitosis.

Abstract

Introduction: In this bibliographic review, problems related to periodontics have been addressed at different levels that can improve or worsen with orthodontics such as open gingival embrasures, problems derived from orthodontics that require periodontal intervention such as gingivitis have also been developed caused by braces, gingival recession or loss of the tooth support. The most common orthodontic problems in periodontal disease have been mentioned, as well as the treatments that improve it at the orthodontic level. Finally, it has been related to orthodontics and implants, in the situation of the loss of a non-restorable tooth, before extraction, extrusion with orthodontics can be performed to increase the bone level.

Objectives: Gingival health has been compared between patients with fixed orthodontics and removable transparent aligners, studied whether the bacterial load in the mouth increases in orthodontic patients and analyzed whether orthodontic appliances produce halitosis.

Methodology: A bibliographic search was carried out in different databases such as *Medline Complete* or *PubMed.*

Discussion: Different articles have been compared to analyze the differences in gingival health, both at the level of the periodontal indices, and at the bacterial level between carriers of various types of braces such as oral and lingual fixed orthodontics or invisible aligners. Also between self-ligating and conventional brackets.

Conclusions: Patients with removable transparent aligners presented better gingival health conditions than fixed orthodontic users; especially significant if we compare it with fixed lingual orthodontics. There are no significant differences between the use of self-ligating brackets and conventional braces. Bacteria associated with orthodontic appliances were practically irrelevant in halitosis.

Índice

Introducción

1.- ¿Qué es la ortodoncia?

La ortodoncia es una de las primeras especialidades dentales que surgen, nació debido al deseo social de tener una dentadura bonita y alineada. Presenta una orientación terapéutica, estudia y atiende el desarrollo de la oclusión y su corrección mediante aparatos mecánicos que van a ejercer fuerzas físicas tanto en los dientes como en el medio circundante. El término ortodoncia fue introducido en 1841 por Defoulon y procede de las palabras griegas *orto* (recto) y *odóntos* (diente).(1)

La ortopedia hizo su aparición poco después para encargarse de la modificación de los huesos maxilares, es más eficaz cuando se aplica sobre la dentición mixta porque actúa de forma precoz.(1)

En definitiva, la ortodoncia es responsable de la supervisión, cuidado y corrección de las estructuras dentofaciales, tanto durante su crecimiento, como en su estado definitivo. Incluye la prevención, el diagnóstico, la intercepción y el tratamiento de todas las formas clínicas de maloclusión y anomalías óseas relacionadas. Así como el diseño y la aplicación de los aparatos terapéuticos. El fin es mantener unas relaciones ideales a nivel dentoesqueléticas, consiguiendo equilibrio funcional y estético. (1)

2.- ¿Qué es la periodoncia?

Es la especialidad que se encarga de mantener el periodonto en estado saludable. La periodontitis es una enfermedad inflamatoria crónica de los tejidos gingivales y el hueso alveolar desencadenada por bacterias presentes en la cavidad oral. Hay ciertos individuos susceptibles genéticamente, en los que si no se trata esta inflamación da como resultado la pérdida de la inserción periodontal y, finalmente, la pérdida de los dientes; también

influyen hábitos como el consumo de tabaco o alcohol. La enfermedad periodontal se inicia mediante la inflamación de las encías, lo que se conoce como gingivitis, en la que las encías presentan un color más rojizo y tendencia a la hemorragia, entre otras características. La gingivitis no siempre progresa a periodontitis, la periodontitis siempre va precedida de gingivitis. La periodontitis, también puede provocar migración patológica dental que ocurre en el 30% a 56% de los pacientes, debida principalmente a la pérdida de hueso, pérdida de dientes e inflamación gingival. (2)(3)(4) (5) (6) (7)

El conocimiento de la patología periodontal es fundamental para planificar y desarrollar el tratamiento de ortodoncia porque es muy frecuente, para un correcto enfoque se necesita un amplio conocimiento de los factores etiopatogénicos implicados y finalmente, porque algunas formas de enfermedad periodontal son muy graves, de tal forma que pueden poner en peligro la dentición, por eso es esencial un diagnóstico precoz, sobre todo, si cuando aparecen estas patologías tan graves hay simultáneamente movimiento ortodóncico. (1)

3.- Problemas relacionados con periodoncia que pueden mejorar o empeorar con el tratamiento de ortodoncia.

En los últimos años ha aumentado el número de pacientes adultos interesados en tratamientos de ortodoncia, por lo que los profesionales se enfrentan cada vez con mayor frecuencia a pacientes con problemas periodontales. Los odontólogos deben estar actualizados y proporcionar una planificación interdisciplinaria del tratamiento. (8) (3)

Se conoce la importancia de mantener una adecuada higiene oral para evitar enfermedades como la gingivitis o la caries, eliminar bien la placa bacteriana resulta más complicado cuando la dentadura presenta malposiciones. Por tanto, la ortodoncia también

contribuye a la prevención de las enfermedades periodontales y a su control, sin embargo, es crucial conseguir una condición periodontal estable sin inflamación, así como un compromiso por parte del paciente con respecto a la higiene oral antes de la intervención de ortodoncia. (8) (3) (5).

Paralelamente, previene el trauma oclusal de repetición debido a una mala oclusión, evitando así lesionar los elementos de sostén dentario, la musculatura y la articulación temporomandibular.(1)

a) Pacientes con enfermedad periodontal.

Es una realidad que cada día hay más pacientes afectados por enfermedad periodontal interesados en tratamiento de ortodoncia, esto se debe a la tendencia creciente de la preocupación por mantener una adecuada salud bucodental. (3)

Para que el tratamiento de ortodoncia sea un éxito, es indispensable partir de una buena salud periodontal. En el momento de planificar el tratamiento de ortodoncia en adultos con antecedentes de enfermedad periodontal, se debe tener en cuenta que se necesita dejar desde el final de la terapia periodontal hasta la colocación del *bracket* un periodo de 2 a 6 meses para remodelar los tejidos, restaurar la salud y evaluar el cumplimiento de la higiene oral por parte del paciente. Con la terapia periodontal adecuada, así como el mantenimiento de una higiene oral óptima por parte del paciente, el tratamiento ortodóncico con aparatología fija es seguro y puede lograr excelentes resultados, incluso cuando presenta pérdida ósea alveolar previa. (8) (9) (10) (5)

Basándose en la evidencia de que la repoblación de bacterias patógenas subgingivales tarda entre seis y ocho semanas, durante el tratamiento de

ortodoncia se debe realizar una limpieza profesional cada tres meses. También, se debe reevaluar el estado periodontal cada 6 a 12 meses midiendo la profundidad de sondaje, la recesión gingival, viendo si hay supuración o sangrado y evaluando el nivel óseo mediante radiografías.(10)

En este tipo de pacientes lo más adecuado es utilizar sistemas sencillos para que no se favorezca el aumento de la acumulación de placa bacteriana, suelen utilizarse dispositivos de anclaje esquelético como los minitornillos, las miniplacas o los implantes dentales que proporcionan un anclaje adecuado cuando las circunstancias son adversas y no es posible otro tipo de anclaje. (8) (10)

El trauma oclusal puede causar una simple defensa del periodonto o una afectación patológica a la que se añaden las bacterias, desembocando en una enfermedad periodontal. Las interferencias oclusales agravan la pérdida de inserción, así como la pérdida ósea y disminuyen significativamente la nueva inserción tras el tratamiento periodontal. En ocasiones, mediante el tratamiento de ortodoncia se puede evitar la situación descrita anteriormente, consiguiendo una distribución uniforme de la aplicación de la fuerza muscular en todo el arco dentario, evitando así perjuicios a nivel periodontal. (10)

La malposición dentaria se puede solucionar mediante tratamiento de ortodoncia, es un factor clave de la recesión como consecuencia de presentar una tabla ósea de menor espesor, puede deberse a una mordida cruzada que se diagnostica cuando aparece un desplazamiento en sentido labial de incisivos inferiores, al apiñamiento dentario, muy frecuente en incisivos inferiores o a una erupción alterada cuando el trayecto de erupción del diente se ha desviado. En las anteriores situaciones es complicado mantener una buena higiene oral, lo que predispone a

sufrir enfermedad periodontal. Se ha comprobado que en zonas donde los dientes se encuentran alineados, hay un menor número de bacterias patógenas periodontales. (11)(10)

En algunos pacientes, no hay suficiente espacio óseo para alinear correctamente sus dientes, lo que se conoce como discrepancia óseo dentaria, en estos casos es necesario recurrir a la extracción para después cerrar el espacio mediante la ortodoncia. En esta situación, hay un 35% de riesgo de que se desarrolle una invaginación gingival lineal con una profundidad de al menos 1mm que puede ocurrir por el aumento de la proliferación del tejido conjuntivo y el epitelio, por un cambio en la morfología ósea, por alteración de la formación de fibras gingivales y transeptales libres o incluso por fractura ósea durante la extracción del diente. En la figura 1, se puede ver que se ha producido una invaginación gingival tras la extracción de un premolar y su posterior cierre de espacio. Consecuentemente, podría producirse un aumento de la pérdida de hueso marginal en los espacios de los dientes adyacentes o una pérdida de hueso en altura a nivel interdental, por lo que el tiempo necesario para el cierre del espacio ortodóncico sería mayor.(5)

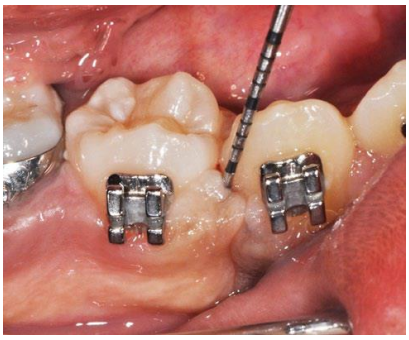

Figura 1. Invaginación gingival tras la extracción de un premolar y cierre de espacio. La profundidad de sondaje dificulta la higiene. (4)

En pacientes periodontales, tras la finalización del tratamiento de ortodoncia es fundamental seguir realizando controles periódicos a nivel periodontal de por vida por el gran peligro de recaída que presentan. Los primeros seguimientos deben realizarse a intervalos de tres meses, un año después del tratamiento, ya se pueden espaciar a seis meses. Siempre hay que evaluar el índice de sangrado, el número de profundidades de sondaje mayor o igual a 5 mm, la pérdida de dientes, la pérdida ósea en relación a la edad y los factores ambientales como el tabaco.(5)

b) Pacientes con periodonto sano.

En pacientes con periodonto en perfectas condiciones, el tratamiento con alineadores invisibles parece ser más favorable para los tejidos periodontales en comparación con los aparatos fijos labiales o linguales.(8)

El movimiento dentario realizado correctamente en condiciones de salud no produce recesiones, pero en presencia de inflamación sí las produce.(1)

c) Pacientes con periodonto reducido.

El movimiento de los dientes en pacientes con periodonto reducido, pero sano, transcurre en las mismas condiciones biológicas que con periodonto intacto, aun así, en estos pacientes hay mayor riesgo de pérdida ósea, de deterioro del periodonto y como suelen presentar maloclusiones complejas, estos casos, suelen requerir adaptaciones en la mecánica y retención del tratamiento. (5)

Diversos estudios clínicos han demostrado que, con un control adecuado de la placa, pacientes con periodonto sano, pero reducido pueden someterse a un tratamiento de ortodoncia sin agravar su condición periodontal, los movimientos

ortodóncicos por sí mismos, no inducen gingivitis. Por el contrario, se ha demostrado que cuando la inflamación no está completamente controlada, el tratamiento de ortodoncia puede desencadenar procesos inflamatorios y acelerar la progresión de la destrucción periodontal, que lleva a una mayor pérdida de inserción, incluso en pacientes con una buena higiene oral. (8) (12)

d) Descripción de los principales índices por los que se mide la salud periodontal.

- Profundidad de sondaje (PD): Se mide con una sonda periodontal desde el margen gingival al fondo de la bolsa periodontal.
- Índice de placa (PI): Mediante un revelador de placa se ven las superficies teñidas del diente que presentan placa. Estas superficies con placa se suman, se divide por el número total de superficies dentarias y se multiplica por 100.
- Sangrado al sondaje (BOP): Se sonda utilizando la sonda periodontal y se comprueba si se produce sangrado.
- Índice gingival (GI): Se sonda en 4 puntos cada diente para comprobar si hay sangrado o no. Se suman las superficies con sangrado, se divide entre el número total de superficies y se multiplica por 100.
- Recesión gingival (REC): Se mide con una sonda periodontal la distancia desde el margen gingival hasta la línea amelocementaria. (13) (14) (6)(15) (16)

e) Troneras gingivales abiertas.

En el tratamiento de las troneras gingivales abiertas es otro punto donde un problema periodontal se puede mejorar mediante ortodoncia. Esta situación en la que aparecen unos antiestéticos triángulos negros entre los dientes se debe a una deficiencia de la papila por debajo del punto de contacto. Se conocen diversos factores de riesgo de desembocan en esta situación como el envejecimiento, la enfermedad periodontal, angulaciones presentes en la raíz de los dientes o coronas de forma triangular, entre otros. Por tanto, se requiere un enfoque multidisciplinar.(17) (5)

Las troneras gingivales abiertas, además de ser antiestéticas, favorecen el avance de la enfermedad periodontal porque se suelen acumular restos de alimentos. Respecto a las raíces divergentes, se demostró que el aumento de 1º en la divergencia de la raíz, considerando que en troneras gingivales normales es de 3´65º, aumenta la probabilidad de aparición de tronera gingival abierta en un 14 al 21%. Mediante el tratamiento con ortodoncia, se pueden situar las raíces de forma paralela, así, el punto de contacto se alargará y moverá hacia apical, al acercarse las coronas entre sí, las fibras transeptales estiradas llenarán la tronera.(17)

Cuando la morfología de la corona es triangular, hay mayor predeterminación a presentar troneras abiertas, en estos casos, se debe realizar una ligera reducción del esmalte para ampliar el área de contacto y después cerrar el espacio.(17)

Si la tronera abierta, está asociada a la pérdida de la papila por enfermedad periodontal, es fundamental una higiene oral exquisita, así como el mantenimiento periodontal programado. Una distancia de 5 mm entre la cresta alveolar y el punto

de contacto se considera saludable para las troneras gingivales, sin embargo, en la enfermedad periodontal, la pérdida de hueso, aumenta esta distancia. Cuando la distancia es de 6 mm la papila está presente en la mitad de los casos, si es mayor de 7 mm, falta la papila en la mayor parte de los casos. (17)

Los procedimientos quirúrgicos para aumentar la papila no son predecibles, puede producirse una contracción y necrosis del tejido por su fragilidad y bajo suministro de sangre, aun así, se ha demostrado cierto éxito empleando los injertos de tejido conectivo y ortodoncia. Los colgajos pediculados han mostrado mejores resultados que los injertos gingivales libres, también es importante para el éxito un biotipo gingival grueso y que no haya enfermedad periodontal activa. El enfoque terapéutico va a depender de la situación en la que se encuentre el paciente.(17)

4.- Problemas relacionados con la ortodoncia que requieren intervención periodontal.

a) Gingivitis por placa. Cómo influyen los aparatos de ortodoncia en el periodonto.

Los aparatos de ortodoncia fijos favorecen la gingivitis porque dificultan la eliminación de placa y por la inflamación de los tejidos debida a la biomecánica de los movimientos dentarios, además, estos aparatos presentan una composición de materiales muy variada, tanto sólidos, como elásticos, así como diferentes diseños. Las superficies irregulares de los *brackets*, bandas, arcos de alambre y otros accesorios de ortodoncia actúan como áreas de retención de placa y también

limitando la capacidad de limpieza mecánica de la saliva. Sin embargo, con un protocolo adecuado de higiene bucal antes y durante el tratamiento de ortodoncia, será evidente un aumento mínimo o nulo en el índice de sangrado gingival y en la cantidad de placa. (8) (11)

iii. Flora bacteriana durante el tratamiento de ortodoncia.

Durante el tratamiento de ortodoncia se puede afectar al equilibrio de la microflora bacteriana oral y aumentar la retención de bacterias. Se ha demostrado que el tratamiento con aparatos de ortodoncia fijos estimula el crecimiento de una placa bacteriana subgingival donde prevalecen algunas bacterias periodontopatógenas como *Porphyromonas gingivalis, Prevotella intermedia, Bacteroides forsythus, Actinobacillus actinomycetemcomitans, Fusobacterium nucleatum* y *Treponema denticola*. (18)

iv. Halitosis.

La halitosis, que significa mal aliento, puede medirse con el halímetro que proporciona una medición objetiva, es portátil, no requiere personal experimentado, tiene una baja probabilidad de infección cruzada y tiene intervalos de 1 a 2 minutos entre las mediciones. (16)

El halímetro mide la cantidad de componentes volátiles de azufre presentes en el aliento. Estos componentes consisten en sulfuro de hidrógeno, sulfuro de dimetilo y especialmente metilmercaptano que se liberan a través de la degradación proteolítica de la saliva, el epitelio exfoliado, los restos de alimentos, el líquido crevicular gingival, la

placa, el goteo posnasal, los aminoácidos que contienen azufre y los péptidos. (16)

Los microorganismos anaeróbicos que se encuentran en la cavidad bucal producen halitosis. Los niveles de componentes volátiles de azufre están influenciados por el número y la profundidad de las bolsas periodontales, la tendencia a sangrar de las bolsas y la cantidad de recubrimiento en la lengua de microorganismos anaerobios gramnegativos. (16)

b) Recesión gingival.

El excesivo movimiento de vestibulización en incisivos se considera que con frecuencia produce recesión gingival, especialmente en la región de los incisivos inferiores, al reducir el espesor de la encía y el hueso, aumenta el riesgo de deshiscencias y fenestraciones óseas unidas a recesión gingival. Se afirma que el movimiento del diente hacia vestibular da como resultado una disminución del ancho labiolingual de la encía labial y una ligera migración apical del margen gingival, mientras que el movimiento labial tiene el impacto opuesto. La recesión depende de diferentes factores asociados al paciente como son la densidad y la morfología ósea o el biotipo gingival, además de representar situaciones antiestéticas, puede producir hipersensibilidad. Existen cuatro factores que demuestran significativamente la formación de una recesión: una infección activa, una recesión ya iniciada, el ancho de la encía queratinizada y el biotipo gingival. (8) (19)(5)

Es de vital importancia identificar el biotipo periodontal antes de iniciar el tratamiento de ortodoncia para evitar el desarrollo de recesión gingival, cuando el biotipo es delgado cualquier movimiento es desfavorable, lo que lleva a una pérdida de anchura de encía queratinizada y aumenta el riesgo de recesión; cuanto más delgado es el biotipo, mayor es la pérdida de anchura de encía queratinizada. La mejor forma para clasificar el biotipo periodontal es utilizando la sonda de biotipo porque es un método fiable y no invasivo. Esta sonda está en tres colores: blanco, verde y azul, se introduce en el surco gingival y dependiendo el color que es visible a través del tejido, se clasifica en biotipo delgado, medio o grueso, si el color que se ve es blanco, verde o azul, respectivamente.(20)

Se recomienda realizar un injerto gingival antes del tratamiento ortodóncico en zonas con menos de 2 mm de encía adherida, raíces prominentes, recesión gingival, exposición de la raíz o cuando se van a realizar movimientos hacia vestibular porque se consideran zonas de alto riesgo para que se produzcan recesiones gingivales o dehiscencias en el futuro. Los injertos de elección son los de tejido conectivo porque proporcionan una mayor estética, mayor grado de cobertura radicular y son menos traumáticos. Por el contrario, cuando se realizan movimientos de los dientes hacia lingual, el margen del tejido migra coronalmente, lo que reduce tanto la recesión gingival, como la deshiscencia, en este caso, no se debe planificar un injerto.(10) (5)

Otro determinante en los cambios morfológicos de las encías, es la velocidad del movimiento ortodóncico, a mayor velocidad, menor opción de remodelado del tejido gingival. Sin embargo, la anatomía gingival y la higiene bucal, son factores

etiológicos más influyentes en la aparición de recesión que el tipo de movimiento dentario o la cantidad de fuerza aplicada. (5)

Las recesiones se pueden reducir al 50% después de la intrusión de dientes periodontalmente comprometidos, independientemente del ancho de la encía. (8) (21)

c) Hipertrofia / hiperplasia gingival.

La hiperplasia gingival derivada del tratamiento de ortodoncia se inicia con una gingivitis producida por la placa bacteriana. Los aparatos ortodóncicos no permiten realizar una higiene oral óptima y favorecen el acumulo de placa, a esto se añade la malposición dentaria, el apiñamiento y la propia morfología gingival de cada individuo. Los márgenes gingivales tumefactos determinan la formación de un surco gingival más profundo que favorece el acumulo de placa en su interior, esta situación mejora rápidamente en las 48 horas posteriores a la extracción de los aparatos. Además, inherente a la biomecánica ortodóncica hay una inflamación tisular. Al cambiar la posición dentaria se remodelan también los tejidos blandos, en los movimientos de cierre de espacios, sobre todo, cuando la encía es gruesa, se comprime y pueden formarse sobrecrecimientos gingivales llamativos debido a la falta de espacio. (1) (8) (10)

d) Pérdida del aparato de sostén del diente.

Al aplicar fuerzas ortodóncicas se va a producir reabsorción en zonas de presión y aposición en zonas de tensión. La presión ejercida en un primer momento va a producir un movimiento dental y a su vez se va a ver disminuida la circulación sanguínea sobre el ligamento, si la fuerza ejercida es muy alta, se produce

hialinización, que impedirá el movimiento dental o hará que no se produzca en la dirección deseada. Esta zona de hialinización se elimina mediante la regeneración del ligamento, una vez que ocurre esto, el diente puede moverse, sin embargo, la eliminación de esta zona no ocurre cuando los tejidos están inflamados. (22)

i. Pérdida longitudinal de la raíz.

La reabsorción radicular es la secuela más común del tratamiento de ortodoncia. Es un proceso inflamatorio que conduce a una necrosis isquémica localizada en el ligamento periodontal cuando se aplica la fuerza de ortodoncia. El inicio y la progresión de la reabsorción radicular están asociados con factores de riesgo relacionados con el tratamiento de ortodoncia, como la duración, la magnitud de la fuerza aplicada, la dirección del movimiento del diente o el método de aplicación de la fuerza (continua / intermitente). Los factores de riesgo relacionados con el paciente son la susceptibilidad genética individual, algunas enfermedades sistémicas, anomalías en la morfología radicular, traumatismo dental y tratamiento endodóntico previo. La prevención se realiza controlando los factores de riesgo. El control radiográfico periódico durante el tratamiento es necesario para detectar la aparición de daños radiculares y reevaluar rápidamente los objetivos del tratamiento. (23)

ii. Pérdida de altura del hueso alveolar.

Los aparatos de ortodoncia, especialmente la ortodoncia fija, pueden producir pérdida de altura del hueso alveolar, se debe a que estos

aparatos dificultan la higiene oral, produciendo acumulación de placa que produce gingivitis y que si no se controla puede dar lugar a periodontitis, haciendo que se produzca la disminución de la altura del hueso alveolar. (22)

A veces, el cierre de espacios en zonas con importante pérdida de hueso, permite mejorar la altura ósea si persiste por lo menos una de las paredes de la bolsa periodontal. Por fortuna, no es frecuente observar una pérdida excesiva de altura en el hueso alveolar como complicación del tratamiento ortodóncico. Esto se debe a que la posición de los dientes determina la posición del hueso alveolar. Cuando los dientes erupcionan o son movilizados, arrastran con ellos el hueso alveolar. La única excepción es el movimiento dental en presencia de trastorno periodontal activo. (22)

5.- Problemas ortodóncicos más comunes en enfermedad periodontal.

Los problemas de ortodoncia más comunes que aparecen en pacientes con enfermedad periodontal incluyen: proinclinación de los dientes anteriores superiores, espaciamiento interdental irregular, rotación, sobreerupción, migración, pérdida de dientes, extrusión u oclusión traumática. La pérdida de molares, a menudo conduce a la inclinación mesial de los dientes posteriores, lo que produce una mordida más profunda con mayor carga oclusal anterior. Las fuerzas musculares periorales desequilibradas y el bruxismo podrían disminuir aún más la función oral y producir incluso alteraciones fonéticas.(8) (3) (24) (10)

6.- Tratamientos ortodóncicos que mejoran la enfermedad periodontal.

a) Intrusión.

Se encuentran suficientes datos clínicos en la literatura científica que sugieren que la intrusión de los dientes afectados periodontalmente puede mejorar de forma considerable el nivel de inserción cuando existe un control absoluto de la inflamación y el biofilm. En estos casos, se sugiere el raspado y alisado radicular a intervalos más cortos porque la intrusión desplaza la placa supragingival a una situación subgingival. Estos resultados beneficiosos eran muy estables a largo plazo (seguimiento de 12 años) en pacientes con compromiso periodontal. Se recomienda el uso de fuerzas ligeras (5 a 15 gr por diente) para mover los dientes de manera eficiente y reducir la cantidad de reabsorción radicular, esto tiene gran importancia en los dientes con periodonto reducido. Realizar movimientos de intrusión descontrolados podría dar lugar a reabsorción radicular, trastornos pulpares, en definitiva, provocar una tensión concentrada en la parte apical del ligamento. (8) (25) (26) (10) (5)

b) Extrusión.

Por otro lado, la extrusión de dientes mediante ortodoncia es útil para reducir efectos infraóseos de media pared, lesiones situadas entre la unión amelocementaria y el tercio coronal de la raíz, así como bolsas periodontales aisladas; aumentando la altura del reborde óseo y la cantidad de encía adherida. (10)

c) Distorrotación de molares.

Al alinear los molares rotados mesialmente se consigue la eliminación de los defectos óseos y también una mejora en la profundidad de sondaje, así como en la relación corona-raíz. Sin embargo, en los molares con afectación de la furca, se podría agravar el problema periodontal durante este procedimiento. Es muy importante tener en cuenta los defectos de furca en los pacientes con tratamiento de ortodoncia porque los molares suelen presentar bandas con tubos y otros accesorios que pueden impedir al paciente el acceso a la furca para limpiarla correctamente, por lo tanto, se requiere reevaluación e instrumentación de los defectos de furca cada dos o tres meses mientras permanezca el aparato de ortodoncia. Tras el tratamiento de ortodoncia, el paciente permanecerá en un programa de mantenimiento periodontal de tres meses, además será reevaluado para planificar las necesidades periodontales que requiera. (8) (27) (10)

7.- Maloclusiones que empeoran la enfermedad periodontal.

Existen ciertas maloclusiones como molares excesivamente inclinados, mordidas profundas traumáticas e incisivos ensanchados y espaciados que empeoran la enfermedad periodontal, esto es debido a una oclusión incorrecta, que produce una tensión excesiva, trauma, problemas funcionales y bruxismo. En la enfermedad periodontal los dientes anteriores se extruyen dejando espacio entre ellos, quedan abanicados. La pérdida molar, a menudo conduce a la inclinación mesial de los dientes posteriores, se pierde dimensión vertical y da como resultado una mordida más profunda con una mayor carga oclusal anterior, desequilibrando las fuerzas musculares periorales; el bruxismo puede disminuir aún más la función oral y pueden ocurrir problemas fonéticos. En definitiva, la corrección de esos problemas, puede ser particularmente beneficioso en personas con compromiso

periodontal porque se podría controlar la degradación periodontal y restaurar la función oral. (3)(28)

8.- Aparatología correctiva más frecuente en ortodoncia.

Dentro de los aparatos ortodóncicos se pueden distinguir fijos y removibles (cuando el propio paciente puede retirarlos). Los aparatos fijos se caracterizan porque usan bandas, arcos de alambre, *brackets*. Estos aparatos fijos pueden ser de tipo labial, cementado sobre la cara vestibular del diente, o de tipo lingual y permiten el movimiento del diente en cualquiera de los tres planos del espacio. Los elásticos intra e intermaxilares forman también parte del conjunto. Los aparatos fijos van a dificultar la higiene porque no pueden ser retirados para realizar el cepillado, presentan este inconveniente respecto a la salud periodontal. Los aparatos fijos de tipo lingual dificultan aún más la higiene. (1)

Los alineadores transparentes termoplásticos son un tipo de ortodoncia removible que se introdujo hace relativamente poco tiempo (1999). Son férulas de plástico transparentes que cubren todos los dientes, así como las zonas marginales de la encía, van moviendo gradualmente los dientes a su posición ideal, deben utilizarse 22 horas al día y son diseñados por ordenador. Presentan la ventaja de ser muy estéticos y se pueden retirar durante el consumo de alimentos y bebidas, así como para la higiene oral, de esta forma se facilita el cepillado dental, manteniendo una buena salud periodontal. (13) (14)

9.- Ortodoncia e implantes.

Ante la situación de un diente no restaurable, la actitud terapéutica es su extracción, pero parece ser que es conveniente realizar una extrusión ortodóncica del diente antes de la colocación del implante, este procedimiento puede ser una alternativa viable a las técnicas

convencionales de aumento óseo en los sitios receptores de implantes. Se indica la aplicación de fuerzas constantes bajas, con una tasa de extrusión no mayor a 2 mm por mes y torque radicular labial para aumentar el grosor vestibulolingual del reborde alveolar. El período de retención antes de la extracción del diente debe exceder de 1 mes. El tiempo total de tratamiento es posiblemente más corto en comparación con el aumento quirúrgico. A día de hoy, se necesitan más investigaciones para comparar clínicamente los resultados de este procedimiento con el convencional. (8) (29)

La ortodoncia en adultos, en algunas ocasiones, debido al edentulismo parcial o a la reducción de soporte del hueso alveolar causado por enfermedad periodontal, carece de puntos de anclaje idóneos, por lo que en estas situaciones es adecuada la extracción de los dientes comprometidos periodontalmente para reponerlos mediante implantes y poder así utilizarlos como anclaje para el tratamiento de ortodoncia. (12)

Objetivos del trabajo

Objetivo principal:

- Comparar la salud gingival entre pacientes portadores de ortodoncia fija y alineadores transparentes removibles.

Objetivos secundarios:

- Estudiar si la carga bacteriana en boca aumenta en pacientes con ortodoncia.
- Analizar si los aparatos de ortodoncia producen halitosis.

Metodología del trabajo

Búsqueda en bases de datos: Para realizar este trabajo de revisión bibliográfica se ha realizado una búsqueda bibliográfica en las siguientes bases de datos: *PubMed, Medline Complete y Cochrane Library*. Se han aceptado artículos procedentes de revistas de impacto como *Journal of Periodontology, Journal of Orthodontics, American Journal of Orthodontics,* siempre escritos en inglés.

Búsqueda avanzada: uso de filtros, operadores booleanos: *AND, NOT, OR*

Para realizar la introducción se han realizado diferentes búsquedas introduciendo los datos que aparecen en la siguiente tabla:

Palabras Clave	Filtros	Resultados
Orthodontics AND periodontics	Ninguno	1.177 artículos
Orthodontics AND periodontics	Texto completo Idioma inglés	768 artículos
Orthodontics AND periodontics	Texto completo Idioma inglés *Dentistry*	339 artículos
Orthodontics AND periodontics	Texto completo Idioma inglés *Dentistry* Periodo 2.000 a 2.021	312 artículos
Interrelation orthodontics periodontics	Ninguno	27 artículos
Interrelation orthodontics periodontics	Texto completo Idioma inglés *Dentistry*	9 artículos
Interrelation orthodontics periodontics	Texto completo Idioma inglés *Dentistry* Periodo 2.000 a 2.021	6 artículos
Periodontal Disease AND orthodontics	Texto completo Idioma inglés *Dentistry* Periodo 2.000 a 2.021	462 artículos

Tabla 1. Búsqueda avanzada introducción

Criterios de inclusión

- Estudios originales prospectivos en sujetos humanos con dentición permanente.
- Estudios sobre tratamiento de ortodoncia con alineadores transparentes.
- Estudios que incluyeron descripciones claras de los materiales y la técnica aplicada.

Criterios de exclusión

- Estudios con menos de 20 pacientes.
- Estudios en animales.
- Estudios en pacientes con síndrome genético y malformaciones faciales graves.
- Estudios con técnicas quirúrgico-ortodóncicas.

Para realizar la discusión se han realizado diferentes búsquedas introduciendo los datos que aparecen en la siguiente tabla:

Palabras Clave	Filtros	Resultados
Orthodontics in periodontal patients	Ninguno	2.378 artículos
Orthodontics in periodontal patients	Texto completo Idioma inglés	1.294 artículos
Orthodontics in periodontal patients	Texto completo Idioma inglés Periodo 2015 a 2021 *Dentistry*	324 artículos
Orthodontics in periodontal patients	Texto completo Idioma inglés Periodo 2015 a 2021 *Dentistry* Revisiones sistemáticas	28 artículos
Fixed appliances AND periodontal health	Ninguno	125 artículos

Fixed appliances AND periodontal health	Texto completo Idioma inglés Periodo 2005 a 2021	82 artículos
Fixed appliances AND periodontal health	Texto completo Idioma inglés Periodo 2005 a 2021 Humano *Dentistry*	44 artículos

Tabla 2. Búsqueda avanzada discusión.

Se seleccionan los artículos que quedan tras utilizar diferentes filtros y siempre que cumplan los criterios de inclusión. Una vez seleccionados los artículos, se empieza leyendo el *abstract* para ir clasificando la información y facilitar su posterior lectura e inclusión en el trabajo de revisión.

Búsqueda manual: a partir de algunos artículos relevantes, se pueden conseguir otros artículos de gran calidad. Los artículos seleccionados para buscar otros artículos interesantes a partir de ellos han sido los que presentan las referencias 3, 6, 8 y 13.

Búsqueda en libros de texto: También se han utilizado en la introducción los siguientes libros de ortodoncia: Ortodoncia clínica y terapéutica de José Antonio Canut Brusola, Ortodoncia Contemporánea de William Proffit, Henry Fields y David Sarver.

Resultados

Tabla de resultados de los estudios de alineadores invisibles y aparatos fijos.

Autor/ Año	Tipo Estudio	Pacientes Edad Media Sexo	Objetivos	Intervenciones	Metodología	Condiciones de salud gingival		Conclusiones
Azaripour/ 2015	Estudio Trans-versal.	O.Fija:50 Invisible:50 16,3 31,9 V:16 V: 11 M:34 M: 39	Estudio salud bucal e higiene y satisfacción.	Ortodoncia fija y alineadores invisibles.	API, SBI, GI y cuestionario para la satisfacción.	A.Fijo: API:37,7% SBI: 15,2% GI:0,54%	A.Invisibles: API:27,8% SBI:7,6% * GI: 0,35% *	Alineadores invisibles mejor salud periodontal y mayor satisfacción.
Miethke/ 2007	Ensayo Clínico.	O.Fija Lingual:30 Invisible:30 39,6	Estudio salud bucal e higiene oral.	Ortodoncia lingual fija y alineadores invisibles.	GI, PBI, PI, PD en 3 citas espaciadas 4 semanas.	A.Fijo Lingual:GI:1,13* PBI: 0,57** PI: 0,79** PD:2,5*	A.Invisibles: GI: 0,68** PBI: 0,21* PI:0,31** PD:2,41	Con alineadores invisibles, índices periodontales más bajos.
Miethke / 2005	Ensayo Clínico.	60 pacientes 30,1 V: 17 M: 43	Estudio salud bucal e higiene oral.	Ortodoncia fija y alineadores invisibles.	GI, PBI, PI, PD en 3 citas espaciadas 4 semanas.	A.Fijo: GI: 0,74** PBI: 0,35** PI: 0,74** PD: 2,44	A.Invisibles: GI: 0,68** PBI: 0,21* PI: 0,31* PD: 2,41	Índice de placa significativamente más bajo para alineadores invisibles.
Madariaga/ 2020	Estudio Clínico Prospec-tivo	40 pacientes 27,6 V:14 M:26	Estudio salud bucal e higiene oral.	Ortodoncia fija y alineadores invisibles	PD, PI, BOP,REC al inicio y a los 3 meses. Reforzando higiene.	A.Fijo.Tras 3 meses: PD: 0% PI: 14,5% * BOP: 13,5%* REC: 5,2 %	A.Invisibles.Tras 3 meses: PD: 0,25% PI:10,5% * BOP: 13,5% * REC: 24,3% *	No mostraron diferencias cuando fueron seguidos por un higienista dental.
Karkhanec hi / 2013	Estudio Clínico Prospec-tivo	O.Fija:22 Invisible 20 34 28 V:6 V: 8 M:16 M: 12	Estudio salud bucal e higiene oral.	Ortodoncia fija y alineadores invisibles.	IP,IG,BOP y PD. Antes, a las 6 semanas, 6 y 12 meses después.	A.Fijo. Tras 12 meses. IP: 1,20 IG: 0,9 BOP: 0,35 PD: 3,1	A.Invisibles. Tras 12 meses IP: 0,55 ** IG: 0,3 ** BOP: 0,2 * PD: 2,54	Alineadores invisibles asociados a una mejora del estado periodontal.

*Tabla 3: *p< 0,05 **p< 00,1. API (índice de placa aproximado), SBI (índice de hemorragia del surco), GI (índice gingival), PBI (índice de sangrado papilar), PI (índice de placa), PD(profundidad de sondaje), BOP(sangrado al sondaje), REC(recesión gingival).*

Tabla de resultados de los estudios de *brackets* convencionales y autoligados.

Autor/ Año	Tipo Estudio	Pacientes Edad Media Sexo	Objetivos	Intervenciones	Metodología	Condiciones de salud gingival			Conclusiones
Kaygisiz / 2015	Ensayo Clínico	60 pacientes 14,7 V: 32 M: 28	Estudio sobre la halitosis y la salud periodontal.	*Brackets* autoligados (SLB) y *brackets* convencionales (CB).	PI, GI, PD, BOP y CVA 1 semana antes, justo antes,1 semana después, 4 y 8 semanas tras el inicio.	SLB, mediciones tras 8 semanas PI: 0,81 GI:0,58 PD:1,46 BOP:2,34	CB PI:0,78 GI:0,38 PD:1,42 BOP:2,11	Control PI: 0,63 GI: 0,47 PD: 1,63 BOP:1,97	Los SLB no tienen ventaja sobre los CB.
Bergamo/ 2016	Ensayo Clínico	20 pacientes 13,3 V:11 M:9	Estudio salud bucal e higiene oral.	*Bracket* convencional (BC) y *Bracket* autoligado (BA) activo y pasivo.	VCG, IP, GBI e GI en 3 sitios *por* diente: mesiobucal (MB)bucal (B) y distobucal (DB) 60 días después.	B.C IP: 1,55* GBI: 0,10 GI: MB:1,20 B:1,15 DB:1,20 VCG: 0,71*	B.A.Activo IP: 1,45* GBI: 0,10 GI: MB:1,20 B:1,10 DB:1,20 VCG:0,72*	B.A.Pasivo IP: 1,75* GBI: 0,20 GI: MB:1,20 B:1,15 DB:1,20 VCG:0,98**	El diseño del *bracket* sí influye en la etapa inicial del tratamiento.
Chhibber / 2017	Ensayo Clínico Aleatorizado Prospectivo	71 pacientes 15,6 V:41 M:30	Estudio salud bucal e higiene oral.	ELB(elastómeros), SLB y alineadores invisibles.	PI, GI, PBI al inicio del tratamiento, a los 9 y a los 18 meses.	A.Invisibles. Tras 18 meses. PI:0,8 GI:0,8 PBI:0,5	ELB PI:1,2 GI:1,1 PBI:0,8	SLB PI:1,1 GI:1 PBI:0,7	No se encuentra evidencia de diferencias en la higiene bucal.
Pandis/ 2008	Investigación de Cohorte Prospectiva	100 pacientes. 12-17 años BC BA V:21 V: 15 M:29 M:35	Estudio salud bucal e higiene oral.	*brackets* convencionales (BC) y *brackets* autoligados (BA)	PI, GI, PD y se hace seguimiento durante 18 meses de media.	BC PI:1,5 GI:1,13 PD:1,83	BA PI:1,65 GI:1,17 PD:1,8		Los *brackets* de autoligado no tienen ventaja.

*Tabla 4: *p< 0,05 **p< 00,1. PI (índice de placa), GI (índice gingival), PD (profundidad de sondaje), BOP (sangrado al sondaje), CVA (componentes volátiles de azufre), VCG (volumen del líquido crevicular gingival), GBI (índice de sangrado gingival), PBI (índice de sangrado papilar).*

Tabla de resultados de los estudios sobre halitosis.

Autor/ Año	Tipo Estudio	Pacientes Edad Media Sexo	Objetivos	Intervenciones	Metodología	Condiciones de salud gingival		Conclusiones
Levrini / 2015	Estudio Pros-pectivo	77 pacientes 24,3 V: 25 M: 52	Estudio salud bucal y cambios microbiológi-cos	Ortodoncia fija y alineadores invisibles.	BOP, PD, PI; masa total de biopelícula y patógenos periodontales. Al inicio al mes, a los 3 meses.	Aparato Fijo. Concentración bacteriana media (CBM)104.536.026	A.Invisibles:Valores inferiores de BOP, PD, PI con p< 0,05. CBM: 2739* CBM control: 8187	Con alineadores invisibles, salud periodontal superior a corto plazo.
Abbate /2015	Ensayo Clínico	50 pacientes 10-18 años	Estudio salud bucal y cambios microbiológi-cos	Ortodoncia fija y alineadores invisibles.	PI, PD, BOP de los dientes 2.1 y 1.6 al inicio y 3, 6 y 12 meses después. FMPS y FMBS al comienzo y tras 12 meses.	A.Fijo: Tras 12 meses FMPS:66,16 FMBS:35,76 PI: 2.1: 2,32 1.6: 2,52 PD 2.1:3,04mm 1.6:3,80 mm BOP:2.1: 64% 1.6: 84%	A.Invisibles.Tras 12 meses FMPS: 22,68 ** FMBS: 15,32 ** PI: 2.1: 0,27* 1.6: 0,45* PD: 2.1: 2,27 mm * 1.6: 2,73 mm * BOP: 2.1: 0% * 1.6: 9% *	Con alineadores invisibles mejor cumplimiento de la higiene bucal y menos reacciones inflamatorias gingivales.
Lombar do /2020	Estudio Longi-tudinal	Fijo:13 Invisible:14 14 21 V:5 V:5 M:8 M:9	Estudio salud bucal y cambios microbiológi-cos.	Ortodoncia fija y alineadores invisibles.	Bacterias en los dientes 1.1 y 1.6 antes del aparato, al mes, a los 3 y 6 meses.	A.Fijo. Carga total de bacterias a los 6 meses. 1.1: 6* 1.6: 5,8*	A.Invisibles.Carga total de bacterias a los 6 meses. 1.1: 4,9 1.6: 5,7	El tipo de aparato influye en la microbiota subgingival.
Rego / 2010	Estudio de Casos Contro-les	Fijo:30 Removible18 14,5 9,6 V:16 V:10 M:14 M:8	Estudio salud bucal y cambios microbiológi-cos.	Ortodoncia fija y ortodoncia removible.	PI, GI, PD y se secuencian las bacterias del surco gingival.	Fijo Control PI:66,8%* PI:47,7 % GI: 43%* GI:15,6% PD:3,6 mm* mm PD: 3,2	Removible Control PI: 58,7%* PI:14,3% GI:19,8%* GI: 8,8% PD: 2,5 mm mm PD: 2,6	Ambos producen cambios significativos en la microbiota oral y en los índices periodontales.

*Tabla 5: *p< 0,05 **p< 00,1. BOP (sangrado al sondaje), PD (profundidad de sondaje), PI (índice de placa), FMPS (puntuación de placa en la boca completa), FMBS (puntuación de sangrado en la boca completa), GI (índice gingival).*

Discusión

En este trabajo de revisión bibliográfica se va a realizar una comparativa entre la salud gingival en pacientes con aparatología de ortodoncia fija y con alineadores transparentes, también se incluyen otros parámetros como la concentración bacteriana o la halitosis.

Aparecen tres tablas en el apartado de resultados (Tabla 3, Tabla 4 y Tabla 5) donde se recogen los resultados de los artículos incluidos en la discusión de este trabajo, indicando los autores y año de publicación, así como el número de integrantes que participaron en dichos estudios o las condiciones de salud gingival en momentos concretos de los mismos.

La ortodoncia fija es de elección especialmente durante la infancia y la adolescencia, al contrario que la ortodoncia invisible que es muy solicitada por adultos debido a su gran estética. Los alineadores invisibles tienen la ventaja de que son retirados para el consumo de alimentos y bebidas, así como para la higiene oral, consiguiendo una limpieza óptima.

Mediante cuestionarios se ha revelado que la satisfacción de los pacientes portadores de alineadores invisibles era mayor que la de los portadores de ortodoncia fija que en el momento de sonreír intentaron inhibir la sonrisa, evitando así mostrar el aparato. Por lo tanto, estos pacientes tienen una calidad de vida superior en comparación con los usuarios de ortodoncia fija. (13)

Los usuarios de ortodoncia lingual parecen haber sido conscientes desde el principio de que la higiene bucal es fundamental con este tipo de tratamiento, aunque existe una mayor dificultad para cepillarse los dientes. (30)

Las condiciones gingivales de los pacientes mejorarán rápidamente después de retirar el aparato o cuando los alineadores solo se usen por la noche, esto puede deberse a una

mayor motivación por mantener los dientes sanos una vez se ven los dientes alineados, además de que aumenta la accesibilidad del cepillo de dientes y el hilo a los espacios interproximales. (30)

En los artículos comparados los pacientes habían recibido instrucciones de higiene oral antes de la colocación de la ortodoncia y en algunos casos, incluso durante el tratamiento un higienista oral los instruyó. (13) (14) (18)(15)

1.- Ortodoncia fija versus alineadores invisibles

Cuando se comparan el tratamiento de ortodoncia fija bucal con los alineadores invisibles la mayoría de autores están de acuerdo en que los parámetros gingivales son más favorables de forma significativa en el caso de los alineadores. El tratamiento con alineadores invisibles se asoció con una mejora del estado periodontal, como lo demuestra la disminución de los niveles de placa, la inflamación gingival, el sangrado al sondaje y la profundidad de las bolsas de sondaje. Cuando ambos grupos cumplen de igual forma con la higiene oral, los índices periodontales del grupo de alineadores invisibles son significativamente mejores, lo que confirma que la higiene bucal se facilita sin los aparatos fijos. En la figura 2 se puede ver la diferencia de placa bacteriana entre ambas arcadas dentarias, la superior con alineadores invisibles y la inferior con ortodoncia fija bucal, donde hay mayor cantidad de placa. (14) (15) (31) (13) (18) (32)(33)

Figura 2. Paciente tratado simultáneamente con un aparato fijo en la mandíbula y alineador invisible en el maxilar. Tras tinción con revelador de placa. (14)

Un higienista dental realizó seguimiento continuo durante tres meses y no se observaron diferencias en la salud periodontal de los dos grupos, incluso, el estado periodontal de los pacientes mejoró en ambos grupos y no se encontró ningún efecto significativo del aparato. Por lo tanto, el paciente requiere instrucciones precisas e individualizadas para la higiene bucal casera, que debe ser continua y rigurosa, por los dispositivos de ortodoncia que conducen a un posible empeoramiento de las condiciones de salud gingival. (6)

Puesto que los alineadores cubren los dientes y la encía marginal casi todo el día, se podrían esperar unos parámetros periodontales inferiores, pero no sucedió porque aunque la cobertura de todas las superficies de los dientes aumente la acumulación de materia blanda, que podría producir una inflamación subcrónica, contando con que los márgenes de los alineadores, casi nunca son perfectamente lisos y pueden producir irritación en la encía, aun así, se compensa por las posibilidades de una higiene óptima. (14)

Solamente en un artículo de los revisados se puede ver que las recesiones gingivales tuvieron mayor presencia en los portadores de alineadores transparentes, esto se podría deber a que el tratamiento de ortodoncia fijo produce un mayor grado de expansión dental por la forma del arco estándar del alambre. (6)

Chhibber et al realizaron un estudio muy interesante en 2018, que contrasta con los anteriormente analizados, donde muestran su desacuerdo con los otros autores, concluyeron que no había evidencia de diferencias en los niveles de higiene bucal entre los alineadores transparentes, los brackets autoligados y los brackets ligados elastoméricos convencionales tras 18 meses de tratamiento de ortodoncia activo. (34)

Dos metaanálisis recientes subrayaron que los alineadores transparentes deben usarse en pacientes con alto riesgo de inflamación gingival, pero el nivel de evidencia fue muy bajo y se requieren más estudios de alta calidad para corroborar estos resultados. (35) (36) (34)

Al comparar pacientes con alineadores invisibles y aparatos linguales fijos, también se demuestra que tienen índices periodontales considerablemente más bajos los tratados con alineadores invisibles, aunque la tendencia es miniaturizar los *brackets* linguales para conseguir una mejor higiene oral. (30)

2.- *Brackets* convencionales versus *Brackets* autoligados

Se realizó un estudio para evaluar los parámetros gingivales, así como el volumen del líquido crevicular gingival después del uso de tres tipos de *brackets* diferentes durante 60 días. Se evaluaron *brackets* metálicos convencionales y dos marcas diferentes de *brackets* de autoligado (In-Ovation ® R y SmartClip ™). Los resultados indicaron un aumento en el índice de placa y el volumen crevicular gingival 60 días después de la unión de los *brackets* de autoligado SmartClip ™, estos resultados nos indican que el diseño del *bracket* sí influye en estos parámetros clínicos, al menos en la etapa inicial del tratamiento. Este estudio está limitado por el tiempo tan corto de seguimiento. (11)

Se esperaba que frente a los *brackets* convencionales, los *brackets* de autoligado obtuvieran mejores valores para el estado periodontal debido a la falta de materiales de

ligadura y a tener menos sitios retentivos, sin embargo, tienen mecanismos de apertura y cierre que pueden proporcionar sitios de retención de placa adicionales. No hubo diferencias significativas en los valores del índice de placa, índice gingival, sangrado al sondaje y profundidad de sondaje entre los grupos, que aumentaron con ambos tipos de *brackets*, por lo tanto, los *brackets* de autoligado no tienen ningún beneficio sobre *brackets* convencionales ligados con acero. Sin embargo, cuando se dan instrucciones de higiene oral, todos los índices periodontales muestran valores mínimos. En 2008, se realizó otro estudio clínico comparativo en 100 sujetos que ratificó los datos expuestos anteriormente. Este estudio hizo seguimiento a los pacientes durante 18 meses, tiempo suficiente para mostrar esta evidencia. (16) (37)

3.- Bacterias periodontopatógenas

Tras la colocación de una banda de ortodoncia se produce un aumento generalizado en el recuento de bacterias salivales, especialmente *Lactobacillus,* también se informó de incremento temprano de anaerobios, *Prevotella intermedia* y una disminución de anaerobios facultativos. Este cambio en la microflora subgingival hacia a una población bacteriana con potencial patogénico a nivel periodontal, es similar a las zonas con enfermedad periodontal. Por el contrario, no se encontró un nivel de patógenos significativamente más alto tras pasar doces meses con las bandas cementadas, sino que se mantuvo. El cambio de la flora bacteriana en pacientes que reciben aparatología fija ocurre en los primeros 3 meses. (18) (12)(10)

Tres meses después del final del tratamiento, se encontró que la situación microbiológica subgingival volvía a niveles casi previos al tratamiento, sin embargo, algunos estudios han argumentado lo contrario. (38) (39)(40)

Si se comparan a este nivel los primeros seis meses con alineadores transparentes frente aparatología fija, se aprecia que después de 3 a 6 meses, hubo un aumento significativo en la carga bacteriana total en el grupo de ortodoncia fija, destacando *Fusobacterium nucleatum* y *Campylobacter rectus,* por el contrario, el grupo con alineadores transparentes mostró una disminución de la carga bacteriana total. (7) (33)

4.- Halitosis

Frecuentemente, la halitosis puede estar relacionada con factores intraorales, entre los que destacan microorganismos anaerobios gram negativos en la placa dental, en las bolsas periodontales, en la saliva y en el dorso de la lengua. Los microorganismos anaeróbicos de la cavidad bucal, liberan a la sangre componentes volátiles de azufre que se pueden medir con un halímetro para detectar su nivel en el aliento y poder diagnosticar halitosis (umbral es 160 ppb).(16)

Los artículos revisados indican que ni los *brackets* convencionales, ni autoligados, así como tampoco los alineadores invisibles influyen sobre la halitosis. El factor más influyente es el recubrimiento de la lengua y no el estado periodontal, por lo que no es necesario recomendar clorhexidina a los pacientes con ortodoncia. (16) (41)

Conclusiones

1.- Los pacientes con alineadores transparentes removibles, presentan mejores condiciones de salud gingival que los usuarios de ortodoncia fija; especialmente significativo si comparamos con ortodoncia fija lingual.

2.- Con los aparatos fijos, aunque haya también una alta motivación por parte de los pacientes es más difícil conseguir esa higiene oral ideal.

3.- La ortodoncia fija aumenta el número de patógenos periodontales.

4.- No hay diferencias significativas entre el uso de *brackets* autoligados y *brackets* convencionales respecto a la salud periodontal.

5.- La carga bacteriana total medida es más alta en portadores de ortodoncia fija que en pacientes con alineadores transparentes, aunque no hay un aumento claro de los patógenos periodontales.

6.- Las bacterias asociadas a los aparatos de ortodoncia no tienen prácticamente relevancia en la halitosis, las más importantes son las bacterias depositadas en la lengua.

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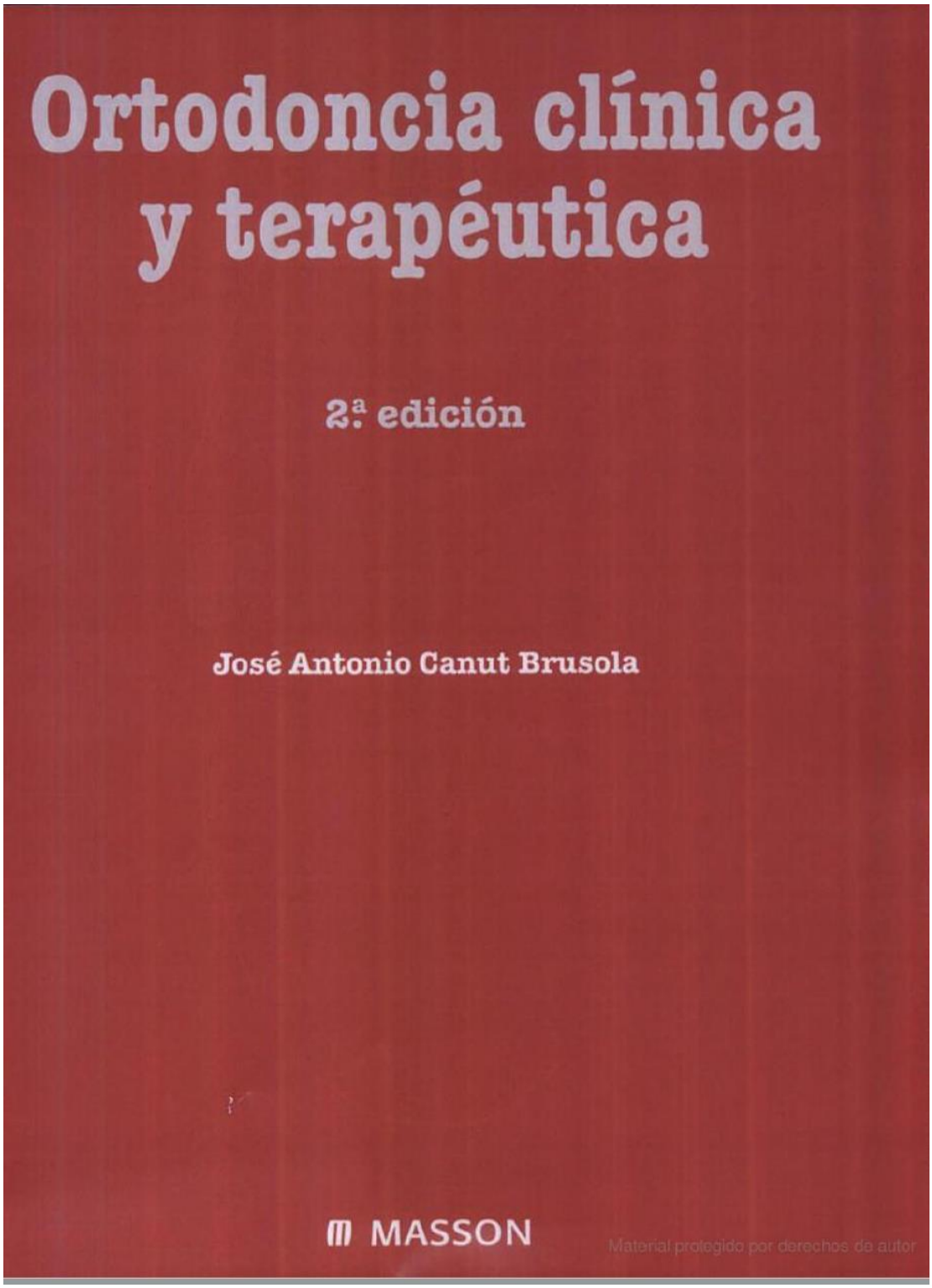
Anexos:


Ortodoncia clínica y terapéutica
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Periodontology 2000, Vol. 69, 2015, 7–17
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Periodontology 2000

Molecular aspects of the pathogenesis of periodontitis

Joerg Meyle & Iain Chapple

The classical model of periodontal disease pathogenesis, developed by Page & Kornman in 1997 (58), provides a key framework to underpin studies aimed at unraveling the complex interdependent relationships that exist both within the plaque biofilm and between the biofilm and the host response (Fig. 1). Almost two decades later, this classical paradigm still has relevance but advances in knowledge require it to be modified to accommodate new discoveries and learnings in the fields of microbiology and immunology, many of which have been driven by the molecular era. This volume of *Periodontology 2000* addresses several of those issues and contains key narrative reviews by luminaries in their relevant fields, some of which have helped inform changes in the classical model of periodontitis pathogenesis to the one illustrated in Fig. 2.

We now recognize that a pathogenic biofilm is a necessary prerequisite for periodontitis to develop but in itself is insufficient to cause the disease. Disease results from complex interactions between the biofilm and the inflammatory immune response, and it is the latter that is estimated to account for almost 80% of the risk of periodontal tissue damage (25). Periodontitis is a complex disease with multiple component causes, some with their basis in genetics, some caused by epigenetic influences and others that are modifiable because they relate to patient behaviors, medications or environmental factors, all of which conspire to establish and propagate the periodontitis lesion. In addition to such 'patient-specific' risk factors, there are also 'site-specific characteristics' (e.g. anatomical factors), which may favor the development of a lesion. The periodontitis phenotype is characterized by an exaggerated, yet poorly effective and nonresolving, inflammation of the connective tissues supporting the teeth that leads to tissue destruction, rather than a specifically targeted, effective and self-resolving inflammatory immune response. Key changes in our perceptions of the infectious immune condition, which we call periodontitis, include:

- the realization that retaining or attaining clinical health requires a health-promoting biofilm within which symbiotic relationships exist between microorganisms and with the host response. The latter can provide key nutrients via gingival crevicular fluid, and the various proteins and peptides released by biofilm organisms trigger a host response that is both proportionate and resolving (52, 71).
- if the biofilm is not disrupted frequently and is allowed to accumulate, the conditions within it start to favor bacterial species, such as *Fusobacterium nucleatum*, that are capable of sensing and influencing their environment by employing chemical cues. Such 'quorum-sensing' organisms start to emerge and elicit a stronger host response, which, in turn, can lead to the development of gingival inflammation and increase the supply of certain nutrients, such as heme, that encourage the proliferation of traditional pathogens such as *Porphyromonas gingivalis*. This is referred to, in Fig. 2, as 'incipient dysbiosis' because in nonsusceptible individuals it does not progress beyond gingivitis.
- in susceptible patients, incipient dysbiosis can trigger an inappropriate, and frequently excessive, host response, in which excess cytokines, reactive oxygen species (oxidative stress) and matrix metalloproteinases are generated and overwhelm their respective antagonists (e.g. antioxidants and tissue inhibitors of matrix metalloproteinases), resulting in collateral periodontal tissue damage. Damage-associated molecular peptides are released, which further propagate the inflammatory response, and a subsequent failure of innate inflammation resolving mechanisms results in

Received: 1 October 2018 | Revised: 30 January 2019 | Accepted: 6 February 2019

DOI: 10.1002/JPER.18-0578

JOURNAL OF Periodontology

ORIGINAL ARTICLE

Interest in orthodontic tooth alignment in adult patients affected by periodontitis: A questionnaire-based cross-sectional pilot study

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Abstract

Background: Orthodontic treatment can successfully align pathologically migrated teeth and lead to improvement of periodontal stability in patients with periodontitis. Periodontic-orthodontic approaches have gained increasing attention in the past years. Here, we investigated the interest of adults affected by chronic periodontitis in undergoing orthodontic treatment as well as patient-related and tooth-related influence factors.

Methods: Periodontal and orthodontic measurements/indices were taken from 115 adult patients with moderate-to-severe periodontitis. The study participants answered a questionnaire investigating patient demographics, quality of life aspects, and their interest in undergoing orthodontic treatment. Correlations between clinical data, questionnaire responses, and this interest were analyzed by means of an age- and sex-adjusted multiple regression model.

Results: Two-thirds of the participants were interested in orthodontic therapy and indicated long-term healthy and esthetically appealing teeth as their main motives. A significant correlation was found between subjectively felt impaired dental esthetics and an interest in orthodontic treatment. However, there were no correlations with the severity of periodontitis, tooth alignment, or patient demographics, including sex. Older patients were significantly more often interested in orthodontic treatment. Most participants had never been provided with information about orthodontic treatment options for adults.

Conclusions: A considerable number of adult patients with periodontitis were interested in orthodontics to improve tooth alignment. However, severity of periodontitis and tooth misalignment or demographic factors may not be indicative thereof. Therefore, dental practitioners need to be aware of patients wishing to align their teeth and to provide them with the relevant information and, if appropriate, enable interdisciplinary treatment planning.

KEYWORDS
adult, esthetics, orthodontics, periodontitis, quality of life, surveys and questionnaires

J Clin Periodontol 1997; 24: 492–497
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JOURNAL OF
clinical periodontology
ISSN 0303-6979

A study on factors associated with pathologic tooth migration

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Martinez-Canut P, Carrasquer A, Magán R, Lorca A: A study on factors associated with pathologic tooth migration. J Clin Periodontol 1997; 24: 492–497. © Munksgaard, 1997.

Abstract. The purpose of this cross-sectional epidemiological study was to determine the prevalence of pathologic tooth migration (PTM) among periodontal patients and to investigate the relationship and degree of association between PTM and the following factors: bone loss, tooth loss, gingival inflammation according to the gingival index, age, lingual interposition, parafunctions and oral habits. 852 periodontal patients (36.7% male, 63.3% female) whose ages ranged from 19 to 72 years (mean 42.5± 9.9) were studied. PTM was defined as the presence of a developing diastema in the upper anterior sextant, which was not present in the past or already existed but increased. Statistical analysis was performed using the Wald test and the Mantel-Haenszel test. Estimates odds ratio were also calculated to assess increased PTM probability as a function of a single variable, or a combination of several. PTM prevalence of 55.8% was found, and it was statistically associated with bone loss ($p<0.001$), tooth loss ($p<0.001$) and gingival inflammation ($p<0.001$), while no association was observed with the remaining variables. The odds ratio indicated that PTM probability increased between 2.95 to 7.97 times as bone loss increased. For tooth loss this probability increased 2.76 times when no tooth loss was compared to 4 or more teeth lost. Likewise the probability increased 2.23 times when the gingival index was above 2. According to the single effect as well as the combined effect of these 3 main factors, it was concluded that: (1) no single factor by itself is clearly associated with PTM: (2) the factor mainly related to PTM is bone loss, followed by tooth loss and gingival inflammation: (3) as bone loss increases, the association of additional factors with PTM, such as tooth loss and gingival inflammation, increases.

Key words: pathologic tooth migration; etiology; epidemiology

Accepted for publication 21 November 1996

Pathologic tooth migration (PTM) has been defined as a tooth displacement that results when the balance among the factors which maintain physiologic tooth position is disturbed by periodontal disease (Carranza 1990). It most commonly occurs in the anterior region and is a common finding associated with periodontal disease (Carranza 1990, Melsen 1991).

The position of the tooth depends on the health and height of the periodontium and on the forces exerted upon the tooth, mainly the occlusion and the pressure of lips, cheeks and tongue. The main predisposing factor to PTM is the loss of periodontal support, since it represents a reduction on the resistance of a tooth to the impact of external factors. As a result, the tooth migrates and secondarily it is subjected to abnormal occlusal forces which aggravate the clinical picture (Carranza 1990).

Among the external factors associated wiht PTM, the literature points out: occlusal trauma per se (Carranza 1990) and the occlusal changes associated with non replaced missing teeth (Hirschfeld & Geiger 1974, Heckert 1980, Marks 1989, Giovanoli & Dersot 1989, Carranza 1990); parafunctions such as bruxism and clenching (Marks & Levitt 1989, Hirschfeld & Geiger 1974, Carranza 1990); lingual interposition related to the shallowing pattern (Dawson 1974, Hirschfeld & Geiger 1974, Marks & Levitt 1989); oral habits (Marks & Levitt 1989) and the pressure of granulomatous tissue of the periodontal pocket (Hirschfeld 1933, Hirschfeld & Geiger 1974, Carranza 1990).

In the past, a pathologically-shifted tooth was considered to have a bad prognosis until in 1933 Hirschfeld approached this problem, showing that these teeth could be maintained for a long term, and some cases could even recover their original position after periodontal treatment. The long term maintenance of natural teeth, in proper function and aesthetics is nowadays a commonly attainable objetive which in many occasions includes orthodontic correction of PTM.

Despite the increasing demand for combined periodontal and orthodontic treatment, literature reporting the prevalence and the mechanisms involved in PTM is scarce and most of the

Journal of Orofacial Orthopedics
Fortschritte der Kieferorthopädie

Review article

Interfaces between orthodontic and periodontal treatment
Their current status

Schnittstellen zwischen kieferorthopädischer und parodontaler Therapie
Eine aktuelle Standortbestimmung

Christoph Reichert[1], Martin Hagner[2], Søren Jepsen[3], Andreas Jäger[1]

Abstract
The contextual relationships between orthodontics and periodontology are diverse and complex. While the consequences of orthodontic tooth movements are discussed in terms of possible damage and improvements in the long-term health of periodontal tissues orthodontic treatment of adults is a routine clinical procedure nowadays, even in patients presenting already-damaged periodontal tissues. As developments in both fields have been so rapid, there is a constant need for evidence-based concepts in this interdisciplinary field.
The goal of this review was to discuss the latest aspects of interdisciplinary treatment and to reflect on the latest developments in research. A treatment scheme is also presented which aims to facilitate coordination of the orthodontic treatment of patients with periodontal diseases.

Keywords
Interdisciplinary treatment · Orthodontic therapy · Periodontal therapy · Periodontal breakdown

Zusammenfassung
Die inhaltlichen Zusammenhänge zwischen den Fächern Kieferorthopädie und Parodontologie sind mannigfaltig. Zum einen werden die Auswirkungen einer kieferorthopädischen Bewegung von Zähnen sowohl im Sinne einer möglichen Schädigung, aber auch im Sinne einer Verbesserung bezüglich der langfristigen Gesundheit der Parodontalgewebe diskutiert. Andererseits ist die kieferorthopädische Behandlung von erwachsenen Patienten auch bei einer Vorschädigung der parodontalen Gewebe heutzutage eine klinische Routinemaßnahme. In Anbetracht der schnellen Entwicklung beider Fächer stellt sich jedoch regelmäßig die Frage nach aktuellen evidenzbasierte Konzepten für diesen interdisziplinären Bereich.
Ziel dieser Arbeit ist es, aktuelle Aspekte in der interdisziplinären Therapie zu diskutieren und den derzeitigen Stand der Forschung wiederzugeben. Weiterhin wird ein Therapieschema vorgestellt, welches die Koordination einer kieferorthopädischen Therapie parodontal erkrankter Patienten erleichtern soll.

Schlüsselwörter
Interdisziplinäre Behandlung · Kieferorthopädische Behandlung · Parodontale Behandlung · Parodontaler Abbau

Introduction

Without evidence-based therapeutic concepts, the orthodontic treatment of patients with periodontal diseases represents a huge challenge for dentists and orthodontists. In this review we consider several important issues concerning interdisciplinary therapy and discuss the interactions between the physiology and pathology of the dental attachment apparatus, with particular attention paid to orthodontic therapy. Periodontal findings with particular relevance to orthodontics are debated.

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Received: January 24, 2011; accepted: March 10, 2011

Einleitung

Die kieferorthopädische Behandlung parodontal erkrankter Patienten stellt bei Abwesenheit evidenzbasierter Therapiekonzepte eine große Herausforderung für die zahnärztliche und die kieferorthopädische Praxis dar. In dieser Übersichtsarbeit sollen einige wichtige Fragestellungen an die interdisziplinäre Therapie reflektiert werden. Es werden Wechselbeziehungen zwischen der Physiologie und Pathologie des Zahnhalteapparates mit besonderem Augenmerk auf die Kieferorthopädie diskutiert. Parodontale Befunde mit besonderer Re-

J Orofac Orthop 2011; 72:165-186
DOI 10.1007/s00056-011-0023-6

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Article

Impact of Fixed Orthodontic Appliance and Clear Aligners on the Periodontal Health: A Prospective Clinical Study

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Received: 23 September 2019; Accepted: 19 December 2019; Published: 2 January 2020

Abstract: This study aimed to evaluate the periodontal health of orthodontic patients with supportive periodontal therapy in a 3 month follow-up. The sample comprised 20 patients (mean age 20.6 ± 8.1 years) in treatment with multibracket fixed appliances (fixed group—FG) and 20 patients (mean age 34.7 ± 12.5 years) in treatment with clear aligners (clear aligners group—CAG). At baseline (T0) and after 3 months (T1), probing depth (PD), plaque index (PI), bleeding on probing (BOP), and gingival recession (REC) were measured. Patients were trained to perform an individualized tooth brushing technique, and every 2 weeks they were re-called to reinforce the oral hygiene instructions. The intra-group comparisons (T1 vs. T0) were calculated with the Wilcoxon signed-rank test, while a linear regression model was used for the inter-group comparisons (FG vs. CAG). The significance level was set at $p < 0.05$. Statistically significant decrease in both groups was found for PD (FG: Δ, −9.2 inter-quartile range (IQR), −22.5, −5.5; CAG: Δ, −12.6 IQR, −25.4, −4.8), BOP (FG: Δ, −53.5 IQR, −70.5, −37; CAG: Δ, −37.5 IQR, −54.5, −23), and PI (FG: Δ, −17.5 IQR, −62.5, 14.5; CAG: Δ, −24 IQR, −49.5, −5). The result of the linear regression models suggested that the type of appliance did not have any effects on the improvement of periodontal variables. Therefore, patients undergoing orthodontic treatment with fixed appliances and clear aligners did not show differences in gingival health when followed by a dental hygienist.

Keywords: fixed orthodontic appliances; clear aligners; oral hygiene; dental plaque; gingival health

1. Introduction

The main etiological factor in the development of gingivitis is the supragingival dental plaque along the gingival margin. Gingivitis is the inflammatory response of the gingival tissues to the metabolic products and pathogenic toxins of bacteria found in the oral biofilm. The inflammatory change of supragingival plaque is a strong predisposing factor for disease progression. Although gingivitis does not always progress to periodontitis, periodontitis is always preceded by gingivitis [1,2].

Periodontal diseases are very common problems in children, adolescents, and adults. Among school children from primary school, almost 55% of individuals experienced some periodontal problems [3]. Also, epidemiological studies revealed a prevalence range of 35%–41% for moderate periodontitis and of 10%–41% for severe periodontitis [4,5]. Furthermore, it has been reported that the prevalence of aggressive and advanced forms of periodontitis is 10%–14% and it increases in the age groups from 35–44 years. [6,7]. Accordingly, more than 70% of adults presented some form of

Received: 30 July 2020 | Revised: 26 August 2020 | Accepted: 29 August 2020

DOI: 10.1111/ocr.12427

ORIGINAL ARTICLE

Orthodontics & Craniofacial Research WILEY

Short-term variation in the subgingival microbiota in two groups of patients treated with clear aligners and vestibular fixed appliances: A longitudinal study

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Funding information
There were no sponsors for this study. The research was funded by the experimenters' own means.

Abstract

Objective: To evaluate the subgingival microbiological changes during the first six months of therapy with clear aligners (CAs) and fixed appliances (FAs). The null hypothesis was that there would be no microbiological differences between the two.

Setting/Sample: Two groups of patients to be treated, respectively, with CAs (14 patients; 9 females and 5 males; mean age 21 years ± 0.25) and FAs (13 patients; 8 females and 5 males; mean 14 years ± 0.75) were consecutively recruited.

Materials and Methods: Subgingival microbiological samples were obtained at the right upper central incisor and right first molar at four different time points: before appliance fitting (T0), and at 1 month (T1), 3 months (T3) and 6 months (T6) thereafter. Total bacterial load (TBL) and counts of the bacteria *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, *Fusobacterium nucleatum*, *Campylobacter rectus*, *Treponema denticola* and *Tannerella forsythia* were determined using real-time PCR.

Results: Total bacterial load did not vary in the CA group, while a significant increase was detected after 3 and 6 months of treatment in the FA group. Unlike red complex species, *C rectus* and *F nucleatum* were often detected: levels remained stable in the CA group but increased progressively in the FA group.

Conclusion: The type of orthodontic appliance influences the subgingival microbiota. TBL increased in the FA group but not in the CA group, although the levels of the individual periodontal pathogenic bacteria species did not significantly increase during the observation period.

KEYWORDS

clear aligner, fixed appliances, periodontal pathogenic bacteria, Real-time PCR, subgingival microbiota

1 | INTRODUCTION

Nowadays, patients of all ages request orthodontic treatment for correcting malocclusion and achieving good aesthetics and function.[1] However, bulky fixed orthodontic equipment is inevitably and closely linked to the accumulation of plaque,[2] which is the main cause of damage to dental and periodontal tissues.

This involves increased plaque and bleeding index levels (PI and BI),[3] periodontal pocket development[4] and marginal alveolar bone loss if untreated,[5] as well as white spot development and caries,[6]

Journal of Oral Rehabilitation
Journal of Oral Rehabilitation 2010 37; 377–390

Review Article

The orthodontic–periodontic interrelationship in integrated treatment challenges: a systematic review

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SUMMARY Orthodontic treatment aims at providing an acceptable functional and aesthetic occlusion with appropriate tooth movements. These movements are strongly related to interactions of teeth with their supportive periodontal tissues. In recent years, because of the increased number of adult patients seeking orthodontic treatment, orthodontists frequently face patients with periodontal problems. Aesthetic considerations, like uneven gingival margins or functional problems resulting from inflammatory periodontal diseases should be considered in orthodontic treatment planning. Furthermore, in cases with severe periodontitis, orthodontics may improve the possibilities of saving and restoring a deteriorated dentition. In modern clinical practice, the contribution of the orthodontist, the periodontist and the general dentist is essential for optimized treatment outcomes. The purpose of this systematic review is to highlight the relationship between orthodontics and periodontics in clinical practice and to improve the level of cooperation between dental practitioners. Potentials and limitations that derive from the interdisciplinary approach of complex orthodontic–periodontal clinical problems are discussed.

KEYWORDS: orthodontics, periodontics, interdisciplinary treatment, aesthetics, function, relapse

Accepted for publication 15 January 2010

Introduction

The most common objectives of an orthodontic treatment are facial and dental aesthetics and the improvement in the masticatory function. There is a continuously increasing number of adult patients who actively seek orthodontic treatment, and it is also an undeniable fact that the incidence of periodontal disease increases with age. Therefore, the number of patients with periodontal problems that attend orthodontic practices is significantly greater than in the past (1).

The most common orthodontic problems found in a periodontally compromised patient include proclination of the maxillary anterior teeth, irregular interdental spacing, rotation, overeruption, migration, loss of teeth (Fig. 1) or traumatic occlusion. Those changes in the dentition are a consequence of the diminished support provided by the compromised periodontium, and they can sometimes hinder periodontal treatment by reducing the conditions for good oral hygiene and impairing function and aesthetics of the stomatognathic system (2). Furthermore, in patients with active periodontal disease, the presence of traumatic occlusion may inhibit bone apposition that can occur following periodontal treatment (3, 4).

In all the aforementioned clinical situations, orthodontic treatment may contribute significantly to the overall rehabilitation (aesthetic and functional) of the stomatognathic system. This is the reason that all these periodontal conditions have to be co-evaluated by the periodontist and the orthodontist to choose the appropriate orthodontic intervention. This may involve adjunct tooth movement that can facilitate other dental procedures or comprehensive orthodontic treatment to correct a malocclusion (5). The final treatment plan must be individualized and tailored to meet the needs, objectives and expectations of the patient (6).

doi: 10.1111/j.1365-2842.2010.02068.x

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Ortho-Perio Interrelationship
Treatment Challenges

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ABSTRACT

It is an undisputed fact that sound periodontal health is a prerequisite for successful orthodontic therapy. Various complex dental problems necessitate a multidisciplinary approach; there cannot be a better example than an ortho-perio interaction. Certain periodontal treatment modalities need to be undertaken before commencing orthodontic treatment. And some periodontal procedures are required after active orthodontic treatment. The aim of this article is to familiarize clinicians in the field of both periodontics and orthodontics with the precautions and clinical techniques necessary to preserve the integrity of already compromised periodontium.

The cornerstone to a successful orthodontic outcome in a periodontally compromised patient depends upon the patient's periodontal health before, during and after active orthodontic treatment. Periodontal disease can result in pathologic migration of involved teeth, which clinically manifests as rotation, elongation and spacing, or crowding of the incisors.[1] These changes might complicate long-term periodontal care by reducing the efficacy of plaque control. They can also compromise the esthetics and function of the dentition.[2] However, if high quality periodontal intervention is performed, and the patient is able to maintain optimal oral hygiene to control the disease, then fixed appliance treatment can be carried out safely and satisfactorily, even in the presence of previous alveolar bone loss.

Thus, the primary aim before commencing orthodontic treatment is to stabilize the periodontal condition.[3] The aim of this article is to review the benefits of integrating orthodontics and periodontics in the management of periodontally compromised patients.

Treating Periodontally Compromised Patients

Before commencing orthodontic treatment, it is mandatory to assess the status of the periodontium. Periodontal screening and recording is highly sensitive in detecting deviations from periodontal health. The Michigan "O" probe and the Marquis probe serve as alternative means of detecting periodontal disease. With proper probe angulation, depth of interproximal osseous defects can be evaluated precisely. OPG serves as an excellent tool for generalized screening; however, the bitewing radiograph is the best diagnostic tool for evaluating periodontal osseous lesions, as it allows better crestal bone evaluation. IOPA may also serve as a viable option for interproximal bone level assessment.[4]

Laboratory markers can supplement these findings to predict high risk sites in these patients. These tests for causative factors include cultures, DNA probes, enzyme-linked immunosorbent assay (ELISA) and benzoyl DL-arginine naptylthylamide (BANA). Tests for susceptible hosts include polymorphonuclear leukocyte chemotaxis, markers for inflammation, tissue damage and cell death (collagenase, elastase, prostaglandins, etc.).[5] Prostaglandin E2 is reported to be a principal mediator of periodontal tissue destruction. Its high levels indicate active disease, whereas low levels are seen in sites of remission and areas with no attachment loss.[6]

SCIENTIFIC SECTION

Journal of Orthodontics, Vol. 43, 2016, 260–267

Gingival crevicular fluid volume and periodontal parameters alterations after use of conventional and self-ligating brackets

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Objective: The aim of this study was to evaluate the alterations on plaque index (PI), gingival index (GI), gingival bleeding index (GBI), and gingival crevicular fluid (GCF) volume after use of three different brackets types for 60 days. **Setting Participants:** The sample comprised 20 patients of both sexes aged 11–15 years (mean age: 13.3 years), with permanent dentition, adequate oral hygiene, and mild tooth crowding, overjet, and overbite. **Methods:** A conventional metallic bracket Gemini™, and two different brands of self-ligating brackets — In-Ovation®R and SmartClip™ — were bonded to the maxillary incisors and canines. PI, GI, GBI scores, and GCF volume were measured before and 30 and 60 days after bonding of the brackets. Data were analysed statistically using non-parametric tests coefficient at a 5% significance level. **Results:** There was no statistically significant correlation ($P > 0.05$) between tooth crowding, overjet, and overbite and the PI, GI, GBI scores, and GCF volume before bonding, indicating no influence of malocclusion on the clinical parameters. Regardless of the bracket design, no statistically significant difference ($P > 0.05$) was found for GI, GBI scores. PI and GCF volume showed a significant difference among the brackets in different periods. In pairwise comparisons a significant difference was observed when compared before with 60 days after bonding, for the teeth bonded with SmartClip™ self-ligating bracket, (PI $P = 0.009$; GCF volume $P = 0.001$). **Conclusion:** There was an increase in PI score and GCF volume 60 days after bonding of SmartClip™ self-ligating brackets, indicating the influence of bracket design on these clinical parameters.

Key words: Gingival crevicular fluid, orthodontic brackets, periodontics, tooth plaque

Received 8th February 2016; accepted 31st July 2016

Introduction

The oral cavity is colonized by diverse groups of bacterial, fungal, and viral pathogens and harbours bacteria that can cause dental caries and periodontal disease if biological imbalance occurs (Socransky et al. 1998; Socransky & Haffajee 2005; Wade 2013).

Plaque accumulation on the tooth surface close to the free gingiva causes gingival inflammation resulting directly from the release of toxins, lipopolysaccharides, or enzymes, and indirectly from the host's body's immune response (Azuma 2006; Sudjalim et al. 2007; Demling et al. 2009; Armitage & Cullinan 2010). The host's protective factors, such as epithelium, gingival crevicular fluid (GCF) flow, immunity, and cell regeneration capacity, may control the activity of periodontal pathogens (Armitage & Cullinan 2010).

Orthodontic appliances produce alterations in the oral environment (Anhoury et al. 2002; Nelson-Filho et al. 2011; Andrucioli et al. 2012) as they are composed of a variety of solid and elastic materials (Steinberg & Eyal 2004) and have different designs (van Gastel et al. 2007). In addition, the irregular surfaces of brackets, bands, archwires, and other orthodontic accessories act as bacterial plaque retention areas (Leung et al. 2006; Magno et al. 2008), hindering dental hygiene, and limiting the mechanical self-cleaning action produced by saliva (Faltermeier et al. 2007). Tooth crowding, overjet, overbite, and open bite may also contribute to

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DOI:10.1080/14653125.2016.1221214

J Clin Periodontol 1998; 25: 271–277
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JOURNAL OF
clinical periodontology
ISSN 0303-6979

Review Article

Interrelationship between periodontics and adult orthodontics

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Ong MA, Wang H-L, Smith FN: Interrelationship between periodontics and adult orthodontics. J Clin Periodontol 1998; 25: 271–277. © Munksgaard, 1998.

Abstract. The purpose of this review article is to provide the dental practitioner with an understanding of the interrelationship between periodontics and orthodontics in adults. Specific areas reviewed are how periodontal tissue reacts to orthodontic forces, influence of tooth movement on the periodontium, effect of circumferential supracrestal fiberotomy in preventing orthodontic relapse, effect of orthodontic bands on the periodontium, specific microbiology associated with orthodontic bands, mucogingival considerations and time relationship between orthodontic and periodontal therapy. In addition, the relationship between orthodontics and implant restorations (e.g., using dental implants as orthodontic anchorage) will be discussed.

Key words: periodontics; orthodontics; tooth movement; mucogingival defects; microbiology; implants; anchorage

Accepted for publication 12 August 1997

The primary objective of periodontal therapy is to restore and maintain the health and integrity of the attachment apparatus of teeth. In adults, the loss of teeth or periodontal support can result in pathological teeth migration involving either a single tooth or a group of teeth. This may result in the development of a median diastema or general spacing of the teeth with or without incisal proclination, rotation or tipping of bicuspids and molars with the collapse of the posterior occlusion and decreasing vertical dimension. Adjunctive orthodontic therapy is necessary to resolve these problems. Additionally, orthodontic therapy can facilitate management of several restorative and aesthetic problems/difficulties relating to fractured teeth, tipped abutment teeth, excess spacing, inadequate pontic space, malformed teeth, hypererupted incisors and diastema/frena as summarized in Table 1. The purpose of this article is to review issues related to periodontics and adult orthodontics.

Periodontal Tissue Response to Orthodontic Forces

Tooth movement during orthodontic therapy is the result of placing controlled forces on teeth. Removable appliances place intermittent tipping forces on teeth while fixed appliances can create continuous multidirectional forces to create torquing, intrusive, extrusive, rotational and bodily movement (Lindhe 1989, Proffit 1993a). Age per se is not a contraindication to orthodontic treatment. With increasing age, cellular activity decreases and the tissue becomes richer in collagen (Reitan 1985). In the elderly, the tissue response to orthodontic forces including both cell mobilization and conversion of collagen fibers is much slower than in children and teenagers (Reitan 1985). In adults, hyalinized zones are formed more easily on the pressure side of an orthodontically moved tooth and these

Table 1. Use of orthodontics as an adjunct to overall treatment

1. Uprighting or repositioning teeth to improve parallelism of abutment teeth (e.g., tipped abutment teeth)
2. Improving future pontic spaces (e.g., inadequate space)
3. Correcting cross-bites
4. Extruding teeth (e.g., fractured teeth)/Intruding teeth (e.g., hypererupted teeth)
5. Correcting crowding of teeth
6. Achieving adequate embrasure space and proper root position
7. Repositioning teeth for placement of implants
8. Restoring lost vertical dimension
9. Increasing or decreasing overjet/ overbite
10. Closure of diastemas

Azaripour et al. BMC Oral Health (2015) 15:69
DOI 10.1186/s12903-015-0060-4

BMC Oral Health

RESEARCH ARTICLE Open Access

Braces versus Invisalign®: gingival parameters and patients' satisfaction during treatment: a cross-sectional study

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Abstract

Background: Fixed orthodontic appliances (FOA) temporarily interfere with periodontal health of patients, as the appliance complicates oral hygiene. The use of aligners in orthodontic therapy increased strongly during the last decade. In the literature, the reports about effects of aligner treatment on oral hygiene and gingival conditions are scarce. This cross-sectional study evaluated oral hygiene and patient's satisfaction during orthodontic treatment of patients with FOA or Invisalign®.

Methods: 100 patients (FOA = 50, Invisalign® = 50) were included who underwent orthodontic treatment for more than 6 months. Clinical examinations were performed to evaluate patients' periodontal condition and were compared with clinical data at the beginning of the orthodontic treatment. Oral hygiene, patients' satisfaction and dietary habits were documented by a detailed questionnaire. For statistical analysis, the Mann–Whitney U-Test and Fisher's Exact Test were used; as multiple testing was applied, a Bonferroni correction was performed.

Results: At the time of clinical examinations, patients with FOA were in orthodontic therapy for 12.9 ± 7.2 months, whereas patients with Invisalign® were in orthodontic therapy for 12.6 ± 7.4 months. Significantly better gingival health conditions were recorded in Invisalign® patients (GI: 0.54 ± 0.50 for FOA versus 0.35 ± 0.34 for Invisalign®; SBI: 15.2 ± 7.6 for FOA versus 7.6 ± 4.1 for Invisalign®), whereas the amount of dental plaque was also less but not significantly different (API: 37.7 % ± 21.9 for FOA versus 27.8 % ± 24.6 for Invisalign®). The evaluation of the questionnaire showed greater patients' satisfaction in patients treated with Invisalign® than with FOA.

Conclusion: Patients treated with Invisalign® have a better periodontal health and greater satisfaction during orthodontic treatment than patients treated with FOA.

Keywords: Aligner, FOA, Braces, Dental hygiene, Periodontal health

Background

Fixed orthodontic appliances (FOA) promote the accumulation of bacterial plaque because FOA limit the ability of patients to perform good oral hygiene, which can lead to temporary destructive periodontal processes [1–4]. Deterioration of the periodontal status and dental decalcification during orthodontic treatment can be avoided only when the patient is incorporated in a stringent recall system [5, 6].

In the majority of patients, particularly during childhood and adolescence, FOA are the treatment of choice. Because of esthetics reasons, this treatment is not very popular for adult orthodontics. Therefore, other orthodontic techniques have been developed to increase esthetics and simplify oral hygiene procedures.

An alternative for FOA is Invisalign® which has been available since 1999 and offers not only the advantage of better esthetics but also the convenience of removal during food and beverage consumption, as well as oral care.

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Journal of Orofacial Orthopedics
Fortschritte der Kieferorthopädie

Original Article

A Comparison of the Periodontal Health of Patients during Treatment with the Invisalign® System and with Fixed Orthodontic Appliances

Vergleich der Parodontalbefunde zwischen Invisalign®- und Multibracketpatienten

Rainer-Reginald Miethke, Silke Vogt[1]

Abstract

Objective: Evaluation of the periodontal health in patients during treatment with either fixed orthodontic appliances or the Invisalign® system.

Study Design: The study was designed as a concomitant trial. The evaluation of the patients started in February 2002 and was completed in August 2003.

Patients and Methods: Thirty consecutive patients each with fixed orthodontic appliances and with aligners were examined at three consecutive control visits for their periodontal condition. All individuals were part of the clientele of the Department of Orthodontics and Dentofacial Orthopedics of the Charité Berlin. The parameters evaluated were the modified Gingival Index, modified Plaque Index, modified Papillary Bleeding Index, and sulcus probing depth. The first three indices were recorded alternatively buccally and lingually in all permanent teeth from central incisor to first molar: buccally in the maxillary right and the mandibular left quadrants, lingually in the maxillary left and mandibular right quadrants. The sulcus depth was measured in four areas: mesially and distally, lingually and buccally in the 1st molar and the 1st premolar of each quadrant. Each control visit was concluded with a detailed, individualized oral hygiene instruction.

Results: The modified Plaque Index was significantly lower in the Invisalign® group overall. On the other hand, the periodontal condition of the two samples was nearly identical.

Conclusion: Periodontal health is not jeopardized, even though the Invisalign® system aligners cover all the teeth and the keratinized gingiva in part. This could be attributed to the fact that aligners are removable and thus allow unimpeded oral hygiene.

Key Words: Invisalign® · Fixed appliances · Periodontium · Gingival Index · Plaque Index · Papillary Bleeding Index · Sulcus probing depth · Oral hygiene

Zusammenfassung

Untersuchungsziel: Vergleich des Parodontalzustandes von Patienten, die mit dem Invisalign®-System beziehungsweise mit festsitzenden Apparaturen behandelt werden.

Studienaufbau: Therapiebegleitende Untersuchung von zwei Gruppen konsekutiver Patienten zwischen Februar 2002 und August 2003.

Patienten und Methoden: Je 30 Patienten mit Alignern oder festsitzenden Apparaturen wurde zu drei verschiedenen Zeitpunkten während ihrer Behandlung parodontologisch untersucht. Alle Probanden entstammten der Klientel der Abteilung für Kieferorthopädie und Orthodontie der Charité Berlin. Der Parodontalzustand wurde mittels eines modifizierten Gingiva-Indexes, eines modifizierten Plaque-Indexes und eines modifizierten Gingivablutungsindexes erfasst; zusätzlich wurde die Sulkustiefe gemessen. Sämtliche Indices wurden im ersten und dritten Quadranten vestibulär, im zweiten und vierten Quadranten oral für alle bleibenden Zähne vom mittleren Schneidezahn bis zum ersten Molaren bestimmt. Die Sulkustiefe wurde am ersten Molar und am ersten Prämolar aller Quadranten mesial und distal, vestibulär und oral festgestellt. An jede Befunderhebung schloss sich eine ausführliche, individuelle Mundhygieneinstruktion an.

Ergebnisse: Die Invisalign®-Patienten wiesen insgesamt einen signifikant besseren modifizierten Plaque-Index auf. Weitere signifikante Unterschiede waren nur zwischen den verschiedenen Untersuchungsterminen in den jeweils einzelnen Gruppen zu beobachten.

Schlussfolgerung: Obwohl bei einer Invisalign®-Behandlung die Zähne und die marginale Gingiva propria fast ganztägig von Alignern bedeckt sind, resultiert daraus kein erhöhtes parodontales Risiko. Dies könnte dadurch erklärbar sein, dass Aligner herausnehmbar sind und eine uneingeschränkte Mundhygiene zulassen.

Schlüsselwörter: Invisalign® · Multibracketapparatur · Parodontium · Gingiva-Index · Plaque-Index · Gingivablutungsindex · Sulkustiefe · Mundhygiene

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Received: September 22, 2004; accepted: February 7, 2005

J Orofac Orthop 2005;66:219–229
DOI 10.1007/s00056-005-0436-1

Journal of Orofacial Orthopedics
Fortschritte der Kieferorthopädie

Original article

Periodontal health in teenagers treated with removable aligners and fixed orthodontic appliances

Parodontale Gesundheit von Teenagern mit herausnehmbaren Alignern und festsitzenden kieferorthopädischen Apparaturen

Gian Marco Abbate[1] · Maria Paola Caria[2] · Paola Montanari[3] · Carla Mannu[4] · Germano Orrù[4] · Alberto Caprioglio[3] · Luca Levrini[1]

Abstract

Objectives. The purpose of this study was to explore the microbiological and periodontal changes occurring in adolescents during 12 months of orthodontic therapy with removable aligners and with fixed appliances.

Material and methods. During the years 2012–2013, 50 teenagers aged 10–18 years with similar initial orthodontic conditions participated in this trial in a university clinic in northern Italy. After receiving professional oral hygiene and instructions on a standardized oral hygiene protocol, the adolescents were randomly assigned to either orthodontic treatment with traditional fixed brackets (n=25) or to treatment with Invisalign® aligners (n=25). Subgingival microbiological samples, probing depth (PD), plaque index (PI), and bleeding on probing (BOP) were obtained and documented from the mesiovestibular subgingival sulcus of the upper right first molar and left central incisor at the beginning of treatment and 3, 6, and 12 months later. Compliance with oral hygiene procedures, full mouth plaque score (FMPS), and full mouth bleeding score (FMBS) were assessed at the beginning of treatment and 12 months later. Two sample independent t-tests and the $\chi 2$ test were used to study whether the indices of periodontal health differed in the teenagers due to the experimental conditions.

Results. None of the patients was positive for the periodontal anaerobes analyzed. The PI, PD, BOP, FMPS, and FMBS scores were

Zusammenfassung

Studienziel. Gegenstand dieser Untersuchung waren die mikrobiologischen und parodontalen Veränderungen bei Jugendlichen über 12 Behandlungsmonate mit herausnehmbaren Alignern oder festsitzenden Apparaturen.

Methode. Die Studie umfasst 50 Teenager (10–18 Jahre) mit vergleichbaren kieferorthopädischen Indikationen, behandelt in den Jahren 2012 und 2013 an einer norditalienischen Universitätsklinik. Nach einer professionellen Hygienesitzung und Unterweisung in einem standardisierten Mundhygieneverfahren erfolgte nach dem Zufallsprinzip die Zuordnung der Jugendlichen zu einer von 2 Behandlungsgruppen mit traditionellen Klebebrackets (n=25) oder Invisalign®-Schienen (n=25). Zu Behandlungsbeginn sowie 3, 6 und 12 Monate danach erfolgten mikrobiologische Probenentnahmen im Oberkiefer aus dem mesiovestibulären Sulkusbereich des rechten ersten Molaren und linken mittleren Schneidezahns sowie eine Beurteilung auf Sondiertiefen, Plaqueindex und provozierte Blutungen. Außerdem beurteilten wir zu Behandlungsbeginn und 12 Monate danach die Hygienedisziplin sowie die Gesamtindizes FMPS (Full Mouth Plaque Score) und FMBS (Full Mouth Bleeding Score). Zweistichproben-t-Tests für unabhängige Stichproben und der $\chi 2$-Test dienten dem Auffinden von Gruppenunterschieden bei den parodontalen Indizes.

Resultate. Tests auf 4 anaerobe Parodontalkeime waren für alle Patienten negativ. Die Invisalign®-Gruppe zeigte gegenüber der Bracket-Gruppe signifikant niedrigere Werte für Plaqueindex, Sondiertiefen, provozierte Blutungen sowie FMPS- und FMBS-Werte. Auch die Hygienedisziplin war in der Invisalign®-Gruppe signifikant besser.

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Received: 2 May 2014; accepted: 28 October 2014; published online: 2 May 2015

J Orofac Orthop 2015; 76:240-250
DOI 10.1007/s00056-015-0285-5

Original Article

Effects of self-ligating and conventional brackets on halitosis and periodontal conditions

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ABSTRACT

Objective: To evaluate the effects of fixed orthodontic treatment with steel-ligated conventional brackets and self-ligating brackets on halitosis and periodontal health.

Materials and Methods: Sixty patients, at the permanent dentition stage aged 12 to 18 years, who had Angle Class I malocclusion with mild-to-moderate crowding were randomly selected. Inclusion criteria were nonsmokers, without systematic disease, and no use of antibiotics and oral mouth rinses during the 2-month period before the study. The patients were subdivided into three groups randomly: the group treated with conventional brackets (group 1, n = 20) ligated with steel ligature wires, the group treated with self-ligating brackets (group 2, n = 20), and the control group (group 3, n = 20). The periodontal records were obtained 1 week before bonding (T1), immediately before bonding (T2), 1 week after bonding (T3), 4 weeks after bonding (T4), and 8 weeks after bonding (T5). Measurements of the control group were repeated within the same periods. The volatile sulfur components determining halitosis were measured with the Halimeter at T2, T3, T4, and T5. A two-way repeated measures of analysis of variance (ANOVA) was used to compare the groups statistically.

Results: No statistically significant group × time interactions were found for plaque index, gingival index, pocket depth, bleeding on probing, and halitosis, which means three independent groups change like each other by time. The risk of tongue coating index (TCI) being 2 was 10.2 times higher at T1 than at T5 ($P < .001$). Therefore, the probability of higher TCI was decreased by time in all groups.

Conclusions: The self-ligating brackets do not have an advantage over conventional brackets with respect to periodontal status and halitosis. (*Angle Orthod.* 2015;85:468–473.)

KEY WORDS: Conventional brackets; Halitosis; Periodontal condition; Self-ligating brackets

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Accepted: June 2014. Submitted: April 2014.
Published Online: August 7, 2014

INTRODUCTION

Halitosis, which means foul breath, might be related to physiologic and/or pathologic reasons[1] such as ear-nose-throat diseases (chronic sinusitis, tonsillitis), gastrointestinal system diseases, diabetes mellitus, and acute rheumatic fever. Also, more frequently, halitosis can be related to intraoral factors, including especially gram-negative anaerobic microorganisms on the dental plaque, in the periodontal pockets, in saliva, and on the dorsum of the tongue.[1,2]

The volatile sulfur components (VSCs) consisting of hydrogen sulfide, dimethyl sulfide, and especially methyl mercaptan releasing through the proteolytic degradation of saliva, exfoliated epithelium, food debris, gingival crevicular fluid, plaque, postnasal drip, sulfur-containing amino acids, and peptides in the blood by the anaerobic microorganisms found in the oral cavity are effective on the formation of halitosis.[2–4] The levels of VSCs in the mouth are also influenced by

Esthetic Considerations in Interdental Papilla: Remediation and Regeneration

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ABSTRACT

This article reviews the etiology and treatment of open gingival embrasures or black triangles. An open gingival embrasure or black triangle occurs as a result of a deficiency of papilla beneath the contact point. The treatment of open embrasures may require restorative, orthodontic and periodontal considerations depending on the underlying etiology. The authors reviewed a total of 42 articles including review of literature, radiographic, cross-sectional, and retrospective studies in Ovid search engine using the terms "open gingival embrasure," "interdental papilla," and "black triangle." The studies provided information regarding etiology, diagnosis, and treatment of open embrasures. There are several risk factors leading to the development of open gingival embrasures. These factors include aging, periodontal disease, loss of height of the alveolar bone relative to the interproximal contact, length of embrasure area, root angulations, interproximal contact position, and triangular-shaped crowns. Treatment of open embrasures requires an interdisciplinary approach of orthodontic, periodontic, and restorative treatment.

CLINICAL SIGNIFICANCE

Open gingival embrasures are complex esthetic and functional problems. An interdisciplinary team approach with the general dentist, orthodontist, and periodontist is critical. Management of open embrasures requires careful evaluation of the underlying etiology.

(*J Esthet Restor Dent* 22:18–30, 2010)

INTRODUCTION

Preserving papilla in the gingival embrasure of the esthetic zone is a key consideration in restorative and orthodontic treatment. Today, with an aging adult population with a history of periodontal disease, open gingival embrasures are a common occurrence. Black triangles occur in more than one-third of adults and therefore, should be discussed with the patient prior to initiating dental treatment.[1,2] Not only are black triangles unesthetic, but they also contribute to retention of food debris, and can adversely affect the health of the periodontium.[1] Understanding the underlying etiology and customizing patient treatment is essential to reducing the frequency and severity of open gingival embrasures. Gingival embrasure is defined as the embrasure cervical to the interproximal contact.[2] It is open if the embrasure

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DOI 10.1111/j.1708-8240.2009.00307.x

Published online: 2019-09-04

Original Article

Periodontal health status in patients treated with the Invisalign® system and fixed orthodontic appliances: A 3 months clinical and microbiological evaluation

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ABSTRACT

Objective: The aim of this prospective study was to compare the periodontal health and the microbiological changes via real-time polymerase chain reaction (PCR) in patients treated with fixed orthodontic appliances and Invisalign® system (Align Technology, Santa Clara, California). **Materials and Methods:** Seventy-seven patients were enrolled in this study and divided into three groups (Invisalign® group, fixed orthodontic appliances group and control group). Plaque index, probing depth, bleeding on probing were assessed. Total biofilm mass and periodontal pathogens were analyzed and detected via real-time PCR. All these data were analyzed at the T0 (beginning of the treatment) T1 (1-month) and T2 (3 months); and statistically compared using the Mann–Whitney test for independent groups. **Results:** After 1-month and after 3 months of treatment there was only one sample with periodontopathic anaerobes found in patient treated using fixed orthodontic appliances. The Invisalign® group showed better results in terms of periodontal health and total biofilm mass compared to the fixed orthodontic appliance group. A statistical significant difference ($P < 0.05$) at the T2 in the total biofilm mass was found between the two groups. **Conclusion:** Patients undergoing orthodontic treatment with the Invisalign® System show a superior periodontal health in the short-term when compared to patients in treatment with fixed orthodontic appliances. Invisalign® should be considered as a first treatment option in patients with risk of developing periodontal disease.

Key words: Clear aligners, fixed orthodontic treatment, Invisalign, microbiological evaluation, periodontal health

INTRODUCTION

Treatment with fixed orthodontic devices such as brackets and bands creates numerous plaque accumulation sites impeding oral hygiene procedures and thus potentially leading to develop white spot lesions, caries, and periodontitis.[1,2]

It is recognized that microbial dental plaque is the main etiologic factor in the development of dental caries and periodontal disease.[3]

Plaque accumulation can favor the transition of the microbial biofilm to a more aggressive periodontopathogenic flora in subgingival periodontal pockets and the production of proinflammatory cytokines.[4,5]

During fixed orthodontic treatment inflammation occurs and pathologic phenomena such as gingivitis, gingival bleeding, gingival enlargement, and increased gingival pocket depth are observed.[6]

How to cite this article: Levrini L, Mangano A, Montanari P, Margherini S, Caprioglio A, Abbate GM. Periodontal health status in patients treated with the Invisalign® system and fixed orthodontic appliances: A 3 months clinical and microbiological evaluation. Eur J Dent 2015;9:404-10.

DOI: 10.4103/1305-7456.163218

Original Article

Correlation Between Mandibular Central Incisor Proclination and Gingival Recession During Fixed Appliance Therapy

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Abstract: The purpose of this study was to determine whether proclination of mandibular central incisors during fixed appliance therapy results in gingival recession. Complete records of 67 patients (39 female and 28 male patients; mean age, 16.4 years; age range, 10–45 years) were used in this retrospective case-control study. Using pretreatment and posttreatment lateral cephalograms, the change in mandibular central incisor inclination was measured to divide the patients into an experimental group (proclination) and a control group (no proclination). Changes in clinical crown length were determined from pretreatment and posttreatment study models, and changes in gingival recession were determined from intraoral slides. Eight of the 67 patients exhibited a measurable increase in gingival recession of at least 0.5 mm, and 27 patients had an increase in clinical crown length of at least 0.5 mm. Statistical analyses showed no correlation between mandibular central incisor proclination and gingival recession or clinical crown length. A *t*-test analysis showed no statistically significant difference in gingival recession or change in clinical crown length between patients whose mandibular central incisors were proclined and those whose incisors were not proclined. Multiple regression analysis demonstrated that age, sex, race, treatment duration, extraction, treatment type, Angle classification, and proclination were not related to gingival recession or change in clinical crown length of mandibular central incisors. We conclude that the degree of proclination of mandibular central incisors during fixed appliance therapy was not correlated to gingival recession in this sample. (*Angle Orthod* 2002;72:238–245.)

Key Words: Tipping; Inclination; Cephalometric; Orthodontics; Periodontics

INTRODUCTION

Fixed appliance orthodontic therapy has been shown to produce deleterious effects on the periodontium, ranging from gingivitis to bone loss.[1] Many of these sequelae can be attributed to plaque accumulation due to the difficulty of maintaining adequate oral hygiene in the presence of bands and brackets. Accordingly, once the fixed appliances are removed after treatment, the inflammation can be expected to resolve.[2–4]

One long-term complication of orthodontic treatment, however, is gingival recession. Numerous studies have shown that irreversible recession can be caused by fixed appliance therapy in 1.3% to 10% of treated cases.[5,6] It is believed that during orthodontic movement, soft tissue attachment moves with the tooth.[4] Dorfman[6] showed that 1.3% of 1150 patients exhibited a decrease in the width of keratinized gingiva with either minimal movement or some labial movement of the mandibular incisors, whereas 0.69% of the patients had an increase in keratinized gingiva associated with significant lingual positioning of the lower incisors. It is widely accepted that 2 mm of keratinized gingiva is enough to withstand orthodontic forces and prevent recession, but preexisting mucogingival defects can be exacerbated during tooth movement.[7] Therefore, it is important to recognize and correct areas of actual or potential stress before orthodontic therapy.[7]

Dorfman[6] suggested that mandibular incisors would be most likely to exhibit this type of pathologic recession because the tooth-arch relationship results in labially prominent teeth covered with a thin or nonexistent labial plate of bone and inadequate or absent keratinized gingiva. Consequently, much research has been directed at this region of the oral cavity.

Previous studies have focused on determining the incidence and predisposing factors for recession, such as oral

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Accepted: December 2001. Submitted: May 2001.

Influence of Periodontal Biotype on Root Surface Exposure During Orthodontic Treatment: A Preliminary Study

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Paola Cannalire, DDS[3]
Giampietro Farronato, MD, DDS[4]

The aim of this study was to investigate the role of periodontal biotype in the development of gingival recession in patients who have undergone orthodontic treatment. A total of 60 mandibular incisors were analyzed. The qualitative assessment of periodontal biotype was performed with the use of a new biotype probe. A strong correlation was found between thin biotype and proinclination in terms of recession depth and keratinized tissue width. Patients with thin periodontal biotype are more prone to gingival margin instability, irrespective of the type of orthodontic movements. Thin periodontal biotype and proinclination orthodontic movement were related to loss of keratinized tissue width. (Int J Periodontics Restorative Dent 2015;35:665–675. doi: 10.11607/prd.2239)

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According to the International Workshop for a Classification of Periodontal Diseases and Conditions, the gingival/soft tissue recessions on the vestibular or lingual surfaces or interproximal (papillary) areas are classified in the group of "development or acquired mucogingival deformities and conditions around teeth"[1] and are defined as the displacement of the marginal tissue apical to the cementoenamel junction. The resulting root exposure is not esthetically pleasing and may lead to dentinal sensitivity and root caries.

The occurrence of gingival recessions is age-dependent and their development begins relatively early in life.[2] Gingival recessions were noticed in more than 60% of Norwegian 20-year-olds and in more than 90% of the older population (> 50 years);[2] in populations deprived of dental care, the occurrence of root exposures was even higher.[2]

Although its etiology is unclear, periodontal disease and mechanical trauma are considered the primary factors in the pathogenesis of gingival recession defects. Traumatic tooth brushing,[3] intra- and perioral piercings,[4] bruxism,[5] and microbiologically induced inflammation in periodontal connective tissue[6] have been proposed as the most important factors. Consanguinity between orthodontic

CLINICAL RESEARCH

S Re
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Reduction of gingival recession following orthodontic intrusion in periodontally compromised patients

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Dates:
Accepted 21 December 2003

To cite this article:
Orthod Craniofacial Res **7,** 2004; 35–39
Re S, Cardaropoli D, Abundo R, Corrente G: Reduction of gingival recession following orthodontic intrusion in periodontally compromised patients

Structured Abstract

Authors – Re S, Cardaropoli D, Abundo R, Corrente G

Objectives – To evaluate the role of orthodontic intrusion and alignment in the reduction of gingival recession (REC) around maxillary incisors of adult periodontal patients.

Design – Prospective clinical study.

Setting and Sample Population – Twenty-eight consecutively treated adult patients, suffering from severe chronic periodontitis and with one upper central incisor extruded and infrabony defect on its mesial site. All patients were seen in a private practice in Turin, Italy. At baseline, all patients presented with REC on the buccal and mesial aspects of the treated teeth.

Measurements and Results – For each patient probing pocket depth (PPD) and REC were assessed at baseline, at the end of treatment and 1-year after the end of treatment. REC was also evaluated independently in patients with narrow (NPB) or wide periodontal biotype (WPB). All parameters showed improvement between initial and final measurements statistically, and showed no changes between final and follow-up measurements. Mean mesial PPD decrease was 4.29 mm, with a residual PPD of 2.50 mm. Mean REC reduction was 0.96 mm on the buccal sites and 1.71 mm on the mesial. No statistical difference was recorded on REC values between groups NPB and WPB.

Conclusion – The presented clinical protocol resulted in improvement of all parameters examined. At the end of orthodontic treatment a predictable reduction of REC was reported, both in patients with thin or wide gingiva.

Key words: gingival recession; orthodontic intrusion; periodontal biotype

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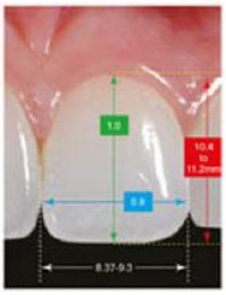

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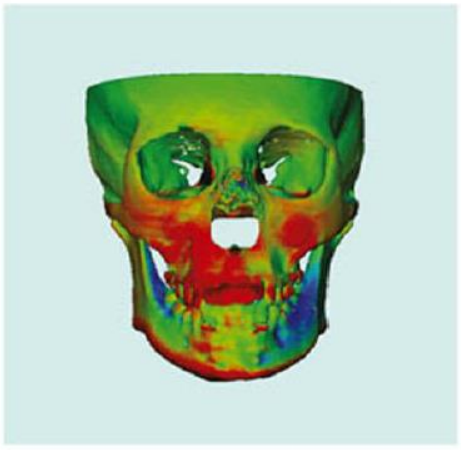

ELSEVIER

Pathologic Migration of Anterior Teeth in Patients With Moderate to Severe Periodontitis

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THE PURPOSE OF THIS STUDY was to determine the prevalence of pathologic migration of anterior teeth in patients with moderate to severe periodontitis. The correlation between pathologic migration of anterior teeth and attachment loss (AL) was investigated, and an attempt was made to identify the most common early form of pathologic migration. Prevalence of tooth migration was studied in a group of 343 patients with moderate to severe periodontitis before treatment. The presence of pathologic migration was determined from the chief complaint and patient awareness of tooth movement in the last 5 years. Forty-four patients (age range 18 to 69; mean = 48.75) with 75 pairs of migrated and non-migrated teeth were studied further to determine if there is a correlation between severity of periodontal AL and pathologic migration. Migrated teeth were compared to control contralateral teeth that did not have migration. In addition, tooth mobility of the anterior teeth on 36 of the 44 patients was measured using the mobility meter. It was anticipated that tooth mobility would follow the same pattern as AL in relation to pathologic migration. The type and severity of displacement was recorded for each tooth affected by migration. The types of pathologic migration recorded were diastema, extrusion, rotation, facial flaring, and drifting into edentulous spaces. Pathologic migration prevalence was 30.03%±2.5 (103/343 subjects). The mean AL of migrated teeth (4.79 ± 0.28 mm) was significantly greater ($P < 0.0001$) than control teeth (3.21 ± 0.18 mm). The numeric values (called PTV) of migrated teeth (17.6 ± 1.5) were significantly greater ($P < 0.0001$) than control teeth (9.4 ± 1.1). It was difficult to identify a primary form of displacement, as most patients demonstrated a combination of movements. The percentage of the 44 patients who presented with a specific type of movement was: facial flaring (90.9 ± 4.4%), diastema (88.6 ± 4.8%), rotation (72.7 ± 6.8%), extrusion (68.2 ± 7.1%), and tipping (13.6 ± 5.2%). The results of this study confirms clinical impressions that periodontal disease destruction of the attachment apparatus plays a major role in the etiology of pathologic migration. *J Periodontol 1997;68:967–972.*

Key Words: Periodontal attachment loss; tooth migration.

One aspect of esthetic dentistry that seems to be overlooked is the problem of pathologic tooth migration related to periodontal disease. Pathologic migration is defined as a change in tooth position resulting from disruption of forces which maintain teeth in a normal position with reference to the skull.[1] Although there is an awareness of pathologic migration, there has been very little information obtained concerning this widespread complication and thus little advancement in the diagnosis, prevention, and treatment of the problem. The prevalence of pathologic migration is not known precisely, but is a common chief complaint of periodontal patients and often motivates them to first seek dental treatment.[2,3] Pathologic migration can be very disfiguring (Fig. 1). Case reports and clinical observations indicate that the etiology is complex and multifactorial. This may explain why there has been very little objective information concerning this troublesome problem.

Several etiologic factors have been listed for pathologic

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Orthodontic Treatment in Periodontally Compromised Patients: 12-Year Report

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*Roberto Abundo, MD, DDS****
*Daniele Cardaropoli, DDS**

This work describes the therapeutic protocol of combined orthodontic-periodontal treatment and evaluates the effectiveness of surgical and nonsurgical periodontal therapy in the maintenance of a healthy periodontal status after the orthodontic treatment. Surgical periodontal treatment was performed in 267 patients affected by severe periodontal disease, and 128 patients had nonsurgical treatment. For each patient the mean value of probing depth (mPPD) and the rate of positive bleeding on probing (%BoP) of the teeth involved in the orthodontic movement were registered before the start of the periodontal treatment, at the end of the orthodontic treatment, and 2, 4 ,6, 10, and 12 years after the end of the orthodontic treatment. Comparison between pretreatment and posttreatment values and between pretreatment and follow-up values showed a decrease in mPPD and %BoP that was of statistical significance. The difference between posttreatment and follow-up values was not statistically significant. These results suggest that orthodontic treatment is no longer a contraindication in the therapy of severe adult periodontitis. In these cases orthodontics improve the possibilities of saving and restoring a deteriorated dentition.
(Int J Periodontics Restorative Dent 2000;20:31–39.)

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The topic of whether orthodontic treatment may have negative effects on periodontal tissues has been investigated in a number of papers.[1,2] In fact, a poorly executed orthodontic tooth movement can increase the risks for adverse effects on the periodontium, especially if the oral hygiene is less effective during the treatment.[3–5]

However, with proper treatment and good oral hygiene maintenance no further periodontal tissue breakdown will occur.[6,7] This may be because of the fact that the effect of orthodontic forces is generally confined to the portion of the periodontium that is bordered by hard tissue on both sides, whereas the suprabony connective tissue remains unaffected.[8,9] With adequate orthodontic-periodontal teamwork it is possible to reestablish a healthy and well-functioning dentition with good occlusion, sufficient masticatory function, and satisfactory esthetics that will improve the psychologic status of the patient after the elongation and the migration of the anterior teeth.[10]

Periodontal changes in furcations resulting from orthodontic uprighting of mandibular molars

James G. Burch* / Bayzit Bagci** / Doreen Sabulski*** / Charles Landrum****

Periodontal examinations were carried out preorthodontically and again 2 to 28 months after orthodontic uprighting of 20 molars (40 furcation areas) in 16 patients. Preorthodontically, patients presented with generalized periodontitis. Postorthodontically, nine of 20 buccal furcations had become more severe, one had improved, and ten remained unchanged. Lingually, nine worsened, and 11 had no change. Furcation area pocket depths increased in 35.0% of furcations, but did not change in 57.5%. Furcation root form was not associated with the degree of change. Possible mesial root extrusion was found in 60.0% of the uprighted molars. The molars showing root extrusion had furcations that increased in severity. Heavy uprighting forces contributed to extrusion, and some effect may have been due to periodontal inflammation and bone loss. Mandibular molars can be uprighted in patients with moderate periodontitis, but light intrusive forces in an inflammation-free environment are recommended.
(Quintessence Int *1992;23:509–513.*)

Introduction

Mandibular molar uprighting is a common orthodontic procedure carried out to enhance periodontal, restorative, and occlusal treatment. Molar uprighting helps reestablish dental, skeletal, and facial vertical support. It enhances oral hygiene procedures and may prevent overpreparation of teeth and the need for endodontic therapy.[1,2]

Brown[2] has described the periodontal changes that occur with the uprighting of a mandibular molar. He described bony and soft tissue changes that occur primarily at the mesial aspect and distal surfaces. Ingber[3] further substantiated bony changes that occur as forced eruption takes place on the mesial aspect of an uprighted molar. However, little information has been reported relative to periodontal responses in the furcation area of uprighted mandibular molars.

Light forces in a healthy periodontium create a supraeruption, an alteration of intrabony deformities, and a decrease in angular bone defects.[4] The presence of inflammation may allow extrusion instead of supraeruption,[5] and further exposure of the furcation may occur[6] with commonly used orthodontic techniques and forces.[7,8] In molars to be uprighted, furcation areas are at risk in a patient with periodontitis if the molar has moderate bone loss, moderate pocket depth, and beginning furcation involvement.

It was the intent of this retrospective study to determine periodontal changes that occurred in furcation areas of mandibular molars that had been uprighted with a common segmental uprighting spring in adult patients who presented generalized moderate periodontitis preorthodontically. Specifically, any evidence of extrusion and worsening of the furcation status was to be assessed. In addition, furcation root form was to

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Periodontology 2000, Vol. 74, 2017, 140–157
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PERIODONTOLOGY 2000

Effect of orthodontic treatment on the periodontal tissues

Joseph S. Antoun, Li Mei, Kelsi Gibbs & Mauro Farella

An increasing number of adult patients are seeking orthodontic treatment, many of whom are likely to have some degree of periodontal disease (21). A reduction in periodontal support can be associated with labial flaring, extrusion, rotation, spacing and drifting of the teeth (150). Such changes are believed to occur when the periodontal ligament is no longer able to stabilize the teeth against external forces (110). Maxillary incisors are particularly susceptible to pathological migration and over-eruption (25). These acquired occlusal changes, along with any underlying skeletal discrepancy, often result in a complex malocclusion that necessitates an interdisciplinary treatment approach (30, 63).

Periodontal disease is not necessarily a contraindication to orthodontic treatment provided that the condition has been stabilized; however, loss of alveolar bone and soft-tissue architecture may pose considerable challenges to oral rehabilitation. It has been suggested that adjunct orthodontic treatment may play an important role in developing the optimal base needed for re-establishing an esthetic and functional dentition in these cases (86). Orthodontic extrusion of unrestorable teeth, for instance, may assist the periodontist and restorative team in harnessing alveolar bone and improving the soft-tissue architecture (150). This adjunct treatment is particularly useful for patients who require dental implants in esthetic zones (71, 78).

Orthodontic therapy may also have detrimental effects, including root resorption (11, 73) and bone dehiscence (44). The introduction of fixed orthodontic appliances into the oral cavity also increases the amount of acidogenic biofilm, thus increasing the risk of gingivitis and caries (62, 149, 152). A critical issue in the treatment planning of any patient revolves around how much orthodontic movement the periodontium can tolerate before it becomes adversely affected.

The envelope of tooth movement

Moving teeth with orthodontic appliances is not without limits. Several factors may influence the extent (and stability) of orthodontic tooth movement, including the anatomy of the alveolar bone, pressures exerted by soft tissues, periodontal tissue attachment levels, neuromuscular forces and lip–tooth relationships (2, 110). It is commonly believed that the limits of tooth movement are defined by strict physiologic and anatomic boundaries, which, if violated, can result in reduced periodontal and alveolar bone support. Accordingly, large movements of teeth beyond this so-called 'envelope of discrepancy' (Fig. 1) are only possible if favorable remodeling of the facial skeleton is achieved or by orthognathic surgery (112). It is unclear, however, how far these boundaries can be pushed before the health of the surrounding tissues becomes adversely affected. This clinical dilemma is particularly evident in borderline extraction cases with reduced periodontal support. There is some anecdotal evidence to suggest that adult patients with severe crowding of the teeth and a reduced periodontium may be successfully treated by moving the teeth beyond the envelope of the alveolar process, albeit using well-controlled force systems (9). One likely reason for such favorable outcomes is variability in tissue response to different treatment mechanics.

Tissue response to orthodontic forces

When orthodontic forces are applied to teeth, both compressive and tensile stresses develop in the surrounding tissues (134). Areas under tension have classically been described as sites of bone apposition, while those under compression undergo bone resorption. The net effect of this remodeling process is the movement of teeth along the direction of the applied force and into the space created by the recently

Review Article

Implant Site Development by Orthodontic Extrusion

A Systematic Review

Mohammed Korayem[a]; Carlos Flores-Mir[b]; Usama Nassar[c]; Kamrin Olfert[d]

ABSTRACT

Objective: To determine the effectiveness of orthodontic extrusion of nonrestorable teeth prior to implant placement for improving the alveolar bone and gingival characteristics of implant recipient sites.

Materials and Methods: Electronic database searches of the following databases were conducted with the help of a senior health sciences librarian: Medline, PubMed, EMBASE, Scopus, Web of Science, and CINAHL Plus. Hand searches of the reference lists of selected articles were also conducted. Abstracts that appeared to fulfill the initial selection criteria were selected for full article retrieval. Retrieved articles were then carefully evaluated, and more specific selection criteria were applied. The authors conducted the selection processes independently, and any differences were resolved through discussion. An analysis of timing, type, and magnitude of forces applied was sought.

Results: Eighteen articles were considered for review. Most of the selected articles were case reports or case series describing orthodontic extrusion of periodontally hopeless maxillary anterior teeth. The results of the reported cases were evaluated individually and collectively with regard to various hard and soft tissue implant site characteristics. Clinically significant gains in alveolar bone and gingival tissue were reported in all cases, resulting in significant quantitative and qualitative improvements in the implant sites.

Conclusions: Based on the available literature, orthodontic extrusion of nonrestorable teeth prior to implant placement appears to be a viable alternative to conventional surgical augmentative procedures in implant site development. No direct comparison to any other method was found, and therefore no conclusion could be made about its relative efficacy.

KEY WORDS: Implant site; Orthodontic extrusion

INTRODUCTION

The quality and quantity of alveolar bone and gingival tissues in potential implant recipient sites is a major determinant of the long-term prognosis of the implant fixture. The primary stability of a dental implant is directly related to the amount of alveolar bone available at the time of implant placement. Implants should be placed in pre-existing bone, while regenerative bone should not be relied on for primary support but merely to obtain coverage.[1]

The three-dimensional morphology of the alveolar bone in potential implant sites is often less than ideal, especially in the anterior region. The inadequate amount of cortical bone in the buccolingual dimension often necessitates surgical or nonsurgical bone augmentation to ensure ideal implant positioning and adequate thread coverage. In cases of immediate implant placement following tooth extraction, the extraction socket left behind immediately after tooth extraction is invariably too large to closely approximate the implant surface, especially in the coronal two-thirds. The conical shape of the socket also precludes a tight fit around the generally cylindrical implant, a problem that is compounded by the almost inevitable coronal socket expansion that occurs during extraction maneuvers.[2]

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Accepted: September 2007. Submitted: July 2007.

Journal of Orofacial Orthopedics
Fortschritte der Kieferorthopädie

Original Article

A Comparison of the Periodontal Health of Patients during Treatment with the Invisalign® System and with Fixed Lingual Appliances

Vergleich der Parodontalbefunde zwischen Invisalign®-Patienten und Patienten mit festsitzenden Lingualapparaturen

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Abstract

Objective: Evaluation of the periodontal health of patients during treatment with the Invisalign® system or fixed lingual appliances.

Study Design: The study was designed as a concomitant trial of two groups of consecutive patients. The lingual patients were evaluated between February and May 2005.

Patients and Methods: Thirty patients each with aligners or fixed lingual appliances were examined at three consecutive control visits for their periodontal status. All the Invisalign® patients and some of those wearing lingual appliances were patients from the Department of Orthodontics and Dentofacial Orthopedics of the Charité Berlin. The rest were recruited from the practices of two licensed orthodontists. The patients' periodontal health was evaluated in reference to a modified Gingiva, modified Plaque and modified Papillary Bleeding Index; we also measured the sulcus probing depth. All indices were documented buccally in the 1st and 3rd quadrants, and lingually in the 2nd and 4th quadrants from central incisor to first molar. The sulcus probing depth was measured mesially, distally, buccally and lingually in each quadrant's first molar and first premolar. Each control visit was concluded with detailed, individualized instructions in oral hygiene.

Results: Overall, the Invisalign® patients demonstrated significantly better modified indices. However, the sulcus probing depths were very similar in both treatment groups.

Conclusion: Although all the teeth and parts of the keratinized gingiva are covered nearly all day during Invisalign® treatment, the periodontal risk is lower than that associated with fixed lingual appliances. This may be due to the fact that aligners are

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Received: December 20, 2006; accepted: March 14, 2007

Zusammenfassung

Untersuchungsziel: Vergleich des Parodontalzustandes von Patienten, die mit dem Invisalign®-System beziehungsweise mit festsitzenden Lingualapparaturen behandelt werden.

Studienaufbau: Therapiebegleitende Untersuchung von zwei Gruppen konsekutiver Patienten. Die Lingualpatienten wurden zwischen Februar 2005 und Mai 2005 erfasst.

Patienten und Methodik: Je 30 Patienten mit Alignern oder festsitzenden Lingualapparaturen wurden zu drei verschiedenen Zeitpunkten während ihrer Behandlung parodontologisch untersucht. Alle Invisalign®-Patienten entstammten der Klientel der Abteilung für Kieferorthopädie und Orthodontie der Charité Berlin. Das galt zum Teil auch für die Patienten mit einer Lingualapparatur, die jedoch zum anderen Teil in zwei Fachpraxen rekrutiert wurden. Der Parodontalzustand aller dieser Patienten wurde mittels eines modifizierten Gingiva-Indexes, eines modifizierten Plaque-Indexes und eines modifizierten Papillenblutungsindexes erfasst; zusätzlich wurde die Sulkustiefe gemessen. Sämtliche Indizes wurden im ersten und dritten Gebissquadranten vestibulär, im zweiten und vierten Quadranten oral für alle bleibenden Zähne von den mittleren Schneidezähnen bis zu den ersten Molaren bestimmt. Die Sulkustiefe wurde am ersten Molaren und am ersten Prämolaren jedes Quadranten mesial und distal, vestibulär und oral festgestellt. An jede Befunderhebung schloss sich eine ausführliche, individuelle Mundhygieneinstruktion an.

Ergebnisse: Die Invisalign®-Patienten wiesen insgesamt signifikant bessere modifizierte Indizes auf; dagegen war die Sulkustiefe bei beiden Therapiegruppen sehr ähnlich.

Schlussfolgerung: Obwohl bei einer Invisalign®-Behandlung die Zähne und die marginalen Anteile der Gingiva propria fast ganztägig von Alignern bedeckt sind, folgt daraus ein geringeres parodontales Risiko, als es von festsitzenden Lingualapparaturen

J Orofac Orthop 2007;68:223–31
DOI 10.1007/s00056-007-0655-8

European Journal of Orthodontics, 2015, 539–543
doi:10.1093/ejo/cju083
Advance Access publication 29 December 2014

Systematic Review

Periodontal health during clear aligners treatment: a systematic review

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Summary

Background: Clear aligner treatment (CAT) has been cited as a safe and comfortable orthodontic procedure for adult patients. However, the available evidence is scarce.
Objective: To perform a systematic review of the existing literature in order to assess periodontal health during CAT.
Search methods and selection criteria: Pubmed, Pubmed Central, National Library of Medicine's Medline, Embase, Cochrane Central Register of Controlled Clinical trials, Web of Knowledge, Scopus, Google Scholar, and LILACS were searched from January 1945 to September 2014 to identify all peer-reviewed papers potentially relevant to the review.
Data collection and analysis: After duplicate selection and extraction procedures, the risk of bias was assessed according to the Centre for Reviews and Dissemination criteria, and a 3-point grading system, as described by the Swedish Council on Technology Assessment in Health Care (SBU), was used to rate the methodological quality of the selected papers. A PICOS table was used for data extraction.
Results: Five relevant articles were selected from the 1247 identified articles. The level of evidence was moderate for all the studies. A significant improvement of the periodontal health indexes was revealed, in particular when CAT was compared to fixed appliances. No periodontal CAT adverse effects were observed in the selected studies.
Conclusions: Periodontal health indexes were significantly improved during CAT. The results of this review should be interpreted with some caution because of the number, quality, and heterogeneity of the included studies.

Introduction

Direct or indirect effects of orthodontic treatments on periodontal status and oral health are well known and quite extensively described in the existing literature (1). The periodontal reaction to an orthodontic appliance depends on several factors, such as host resistance, the presence of systemic conditions, and the amount and composition of dental plaque. Lifestyle factors, including smoking, can also compromise periodontal support. Oral hygiene procedures have a great impact on the periodontal health during orthodontic treatment (2). The existing literature supports the link between the increase of plaque indexes (PIs) and the decrease in overall oral health conditions in orthodontic patients, especially when treated with fixed appliances (3–6). The use of removable appliances can minimize the orthodontics-related negative effects on periodontal health allowing patients easier oral hygiene procedures.

In recent years, increasing numbers of adult patients have sought orthodontic treatment and expressed a desire for aesthetic and comfortable alternatives to conventional fixed appliances (7, 8).

Clear aligners treatment (CAT) was introduced to answer this requests. Although CAT has been cited as a safe, aesthetic and comfortable orthodontic procedure for adult patients, only few trials

Original Article

Periodontal status of adult patients treated with fixed buccal appliances and removable aligners over one year of active orthodontic therapy

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ABSTRACT

Objective: To compare the periodontal status of adults treated with fixed buccal orthodontic appliances vs removable orthodontic aligners over 1 year of active therapy.

Materials and Methods: The study population consisted of 42 subjects; 22 treated with fixed buccal orthodontic appliances and 20 treated with removable aligners. Clinical indices recorded included: plaque index (PI), gingival index (GI), bleeding on probing (BOP), and probing pocket depth (PPD). Plaque samples were assessed for hydrolysis of N-benzoyl-DL-arginine-naphthylamide (BANA test). Indices and BANA scores were recorded before treatment and at 6 weeks, 6 months, and 12 months after initiation of orthodontic therapy.

Results: After 6 weeks, only mean PPD was greater in the fixed buccal orthodontic appliance group. However, after 6 months, the fixed buccal orthodontic appliance group had significantly greater mean PI, PPD, and GI scores and was 5.739 times more likely to have a higher BANA score. After 12 months, the fixed buccal orthodontic appliance group continued to have greater mean PI, GI, and PPD, while a trend was noted for higher BANA scores and BOP.

Conclusions: These results suggest treatment with fixed buccal orthodontic appliances is associated with decreased periodontal status and increased levels of periodontopathic bacteria when compared to treatment with removable aligners over the 12-month study duration. (*Angle Orthod.* 2013;83:146–151.)

KEY WORDS: Fixed orthodontic appliances; Orthodontic aligners; Gingival inflammation

INTRODUCTION

The introduction of esthetic orthodontic treatment options has prompted an increasing number of adults to request orthodontic therapy. In contrast to the adolescent patient, in whom caries is the primary dental concern, the adult patient may also present with, or be at risk for, periodontal diseases.[1] Data from NHANES III suggest 14% of the US population over 20 years of age have moderate to severe periodontitis.[2] Depending upon the criteria used to define periodontal disease status and severity, some epidemiologic studies have reported an even greater prevalence of periodontal diseases.[3] Therefore, as more adults enter orthodontic therapy, the practitioner must consider the effects that orthodontic treatment, including appliance type, may have on periodontal health.

The entire periodontium, including osseous and soft tissue components, remodels with orthodontic tooth movement.[4] However, the presence of periodontal inflammation may inhibit remodeling and compromise the outcome of treatment through the loss of periodontal

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Accepted: May 2012. Submitted: March 2012.
Published Online: June 22, 2012

Clinical and microbiological studies of children and adolescents receiving orthodontic treatment

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Abstract: Purpose: This case-controlled study examined clinical and microbiological parameters in Brazilian children and adolescents receiving orthodontic treatment using fixed orthodontic appliances or removable orthodontic appliances. **Methods:** The plaque index, gingival index, number of decayed, missing and filled teeth, and probing pocket depth was measured on each fully erupted tooth in 30 patients treated with fixed orthodontic appliances and an equal number of age and sex-matched control subjects. The same parameters were also measured in 18 patients treated with removable orthodontic appliances and an equal number of age and sex-matched control subjects. In the patients treated with fixed orthodontic appliances, subgingival plaque samples were collected from four teeth with orthodontic brackets and from four teeth with orthodontic bands. In the patients with removable appliances, subgingival plaque samples were collected from clasped maxillary permanent first molar teeth and from four unclasped permanent teeth. Samples of unstimulated whole saliva and samples from the dorsal surface of the tongue were also obtained from each subject. Each sample was analyzed for the presence of 19 target bacteria by dot blot. A subset of samples was examined by direct amplification of bacterial nucleic acids. **Results:** Compared to their respective age and sex-matched controls, whole mouth means for plaque index and gingival index were significantly elevated in both the fixed and removable orthodontic groups. There was no difference in the DMFT. Subjects with fixed orthodontic appliances had a higher prevalence of each of the target species except for *L. fermentum*, *Neisseriaceae* and *S. mutans*. The prevalence of *A. naeslundii* and *Streptococcus sp.* was significantly higher on teeth with orthodontic brackets alone compared to teeth with both orthodontic bands and brackets. Subjects with removable orthodontic appliances had a higher prevalence of *A. actinomycetemcomitans*, *C. rectus*, *E. corrodens*, *L. fermentum*, *Neisseriaceae*, and spirochetes. The prevalence of *Neisseriaceae* was significantly higher on unclasped teeth compared to clasped teeth. There was no difference between sample sites for the target bacteria except for *A. actinomycetemcomitans* that was detected less frequently in saliva. Orthodontic patients demonstrated higher proportions of gram negative species by direct amplification of nucleic acids including species frequently associated with periodontal disease as well as rarely cultivable or non-cultivable species such as *Abiotrophia defectiva*, *Gemella haemolysans*, *Granulicatella adiacens*, *Lautropia sp.*, *Terrahaemophilus aromaticivorans*, and TM7 bacterium. (*Am J Dent* 2010;23:317-323).

Clinical significance: Both fixed and removable orthodontic appliances can cause alterations in oral biofilms resulting in increased gingival inflammation and which necessitate meticulous oral hygiene during orthodontic treatment.

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Introduction

Orthodontic treatment can sometimes adversely affect oral health. The plaque retentive properties of orthodontic appliances coupled with poor oral hygiene[1] can contribute to the development of dental caries,[2] gingivitis[3,4] and periodontal attachment loss especially around posterior teeth.[5] However, only a few studies have examined the effect of orthodontic treatment on oral biofilms. Orthodontic treatment has been associated with increased numbers of overall bacteria,[6] increased numbers and proportions of spirochetes, motile rods, and fusiforms[7-9] and increased numbers of periodontal patho-gens such as *Aggregatibacter* (*Actinobacillus*) *actinomycetemcomitans*.[10,11] In the present study, we examined the clinical and microbiological changes associated with orthodontic treatment in Brazilian children and adolescents.

Materials and Methods

Study population - This case-controlled study examined 30 patients (16 males, 14 females mean age 14.5 ± 1.7 years) treated with fixed orthodontic appliances and 18 patients (10 males, eight females, mean age 9.6 ± 1.5 years) treated with removable orthodontic appliances. There were separate age and sex-matched control groups for the patients treated with fixed orthodontic appliances and for the patients treated with removable orthodontic appliances. All subjects were recruited from the Orthodontics Clinics at the School of Dentistry at Araraquara (Araraquara, SP, Brazil). Fixed orthodontic appliances had been in place for an average of 21.8 ± 9.8 months prior to the study. Removable orthodontic appliances had been in place for an average of 9.8 ± 2.9 months. The sample sizes (30 test and 30 control subjects for the fixed orthodontic appliance group and 18 test and 18 control subjects for the removable orthodontic appliance group) were calculated based on previous studies reporting statistically significant differences between clinical periodontal parameters.[1,4,9,11]

Subjects were excluded if they had; (1) taken antibiotics or anti-inflammatory drugs within the previous 3 months, (2) received periodontal therapy within 6 months, or (3) had a chronic medical disease or condition that could affect their periodontium. The study protocol was explained to the subject

RANDOMIZED CONTROLLED TRIAL CE AJO-DO

Which orthodontic appliance is best for oral hygiene? A randomized clinical trial

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Introduction: Clear aligners and to a lesser extent self-ligated brackets are considered to facilitate better oral hygiene than traditional fixed orthodontic appliances. This 3-arm parallel-group prospective randomized clinical trial compared the long-term and short-term effects of clear aligners, self-ligated brackets, and conventional (elastomeric-ligated) brackets on patients' oral hygiene during active orthodontic treatment. **Methods:** Seventy-one participants (41 boys, 30 girls; mean age, 15.6 years) undergoing orthodontic treatment were randomly allocated through a computer-generated randomization schedule to one of the groups based on the choice of intervention: Clear Aligners (CLA) (Align Technology, San Jose, Calif) (n = 27), preadjusted edgewise fixed appliance with self-ligated brackets (SLB) (Carriere, Carlsbad, Calif (n = 22), or preadjusted edgewise fixed appliance with elastomeric ligated brackets (ELB) (Ortho Organizers Inc., Carlsbad, CA) (n = 22). For each participant, the primary outcome, plaque index (PI), and secondary outcomes, gingival Index (GI) and periodontal bleeding index (PBI), were measured at baseline (T0), after 9 months of treatment (T1), and after 18 months of treatment (T2). Blinding of the clinicians and the patients to the intervention was impossible. It was only done for outcome assessment and for the statistician. Ten participants did not receive the allocated intervention for various reasons. **Results:** The means and standard deviations of PI at T0 (CLA, 0.50 ± 0.51; SLB, 0.65 ± 0.49; ELB, 0.70 ± 0.73), T1 (CLA, 0.83 ± 0.48; SLB, 1.38 ± 0.72; ELB, 1.32 ± 0.67), and T2 (CLA, 0.92 ± 0.58; SLB, 1.07 ± 0.59; ELB, 1.32 ± 0.67) were similar. The odds ratio (OR) for plaque index (0 or ≥1) comparing SLB or CLA to ELB was not significant. OR for SLB vs ELB = 1.54 at T0 (95% CI, 0.39-6.27), 0.88 at T1 (95% CI, 0.03-24.69), and 0.83 at T2 (95% CI, 0.02-27.70); OR for CLA vs ELB = 1.07 at T0 (95% CI, 0.30-3.88), 0.24 at T1 (95% CI, 0.01-1.98), and 0.17 at T2 (95% CI, 0.01-1.71). However, the odds ratios comparing CLA with ELB for GI (OR = 0.14; $P = 0.015$) and PBI (OR = 0.10; $P = 0.012$) were statistically significant at T1. **Conclusions:** In this prospective randomized clinical trial, we found no evidence of differences in oral hygiene levels among clear aligners, self-ligated brackets, and conventional elastomeric ligated brackets after 18 months of active orthodontic treatment. **Registration:** The trial is registered at ClinicalTrials.gov (NCT02745626). **Protocol:** The protocol was not published before trial commencement. (Am J Orthod Dentofacial Orthop 2018;153:175-83)

Dental plaque is considered to be the primary etiologic factor for gingival inflammation and periodontitis.[1] Its development has been associated with several environmental and individual factors including diet, oral hygiene, fluoride exposure, quality of saliva, composition of oral microflora, and immune factors.[2-4] Plaque accumulation is also a concern with orthodontic devices such as bonded brackets, archwires, and elastics because they hinder access to good oral hygiene measures causing gingival inflammation and subsequent decalcification.[5,6] Numerous studies have evaluated the effect of fixed orthodontic appliances on microbial flora[7-10] and periodontal status[10-16]; however, only a few have compared different appliances or modalities of treatment as an additional factor.[10,12,13,15,16] The choice of orthodontic appliance might be an important factor to consider, assuming that orthodontic therapy results in small detrimental effects to the periodontium.[14]

Although self-ligated brackets and clear aligners are considered to facilitate better oral hygiene when compared with conventional (elastomeric-ligated) brackets, there are conflicting reports in the literature.

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Submitted, February 2017; revised, September 2017.
0889-5406/$36.00

https://doi.org/10.1016/j.ajodo.2017.10.009

Systematic Review and Meta-Analysis

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Assessment of the periodontal health status in patients undergoing orthodontic treatment with fixed appliances and Invisalign system

A meta-analysis

Haili Lu, MD, Haifang Tang, MD, Tian Zhou, MD, Na Kang, MD, PhD*

Abstract

Background: At present, many scholars have studied the periodontal health status of patients undergoing orthodontic treatment with fixed appliances and invisalign. However, those results are inconsistent. Therefore, we conducted this meta-analysis, and then provide reference for clinical treatment.

Methods: Most databases, such as the Cochrane Library, EMBASE, PubMed, Medline, Chinese Biomedical Literature Database, CNKI, and Wan Fang Data were retrieved for related articles from the establishment of the database to October 2017. Meanwhile, we also searched the references of the related literatures manually, in order to increase the included literatures. Two researchers screened the related literatures according to the inclusion criteria and exclusion criteria. Stata 12.0 software was used for data analysis, and results are estimated by odds ratio (OR) and 95% confidence interval (CI).

Results: Finally, 7 articles, including 368 patients, were included into our meta-analysis. Meta-analysis results showed that there was no statistically significant difference of gingival index (GI) and sulcus probing depth (SPD) status between the invisalign group and the control group, including at 1, 3, and 6 months (all $P > .05$). When compared with the control group, the invisalign group presented a lower plaque index (PLI) and sulcus bleeding index (SBI) status at 1 month (OR = −0.53, 95% CI: −0.89 to −0.18; OR = −0.44, 95% CI: −0.70 to −0.19, respectively), 3 months (OR = −0.69, 95% CI: −1.12 to −0.27; OR = −0.49, 95% CI: −0.93 to −0.05, respectively), and 6 months (OR = −0.91, 95% CI: −1.47 to −0.35; OR = −0.40, 95% CI: −0.63 to −0.07, respectively). Subgroup analysis showed that the SPD status was lower in the invisalign group at 6 months when measured the teeth using Ramfjord index (OR = −0.74, 95% CI: −1.35 to −0.12). However, there was no statistically significant difference between the 2 groups when using other measure methods (OR = 0.12, 95% CI: −0.26 to 0.17).

Conclusion: Our meta-analysis suggests that comparing with the traditional fixed appliances, patients treated with invisalign have a better periodontal health. However, more studies are needed to confirm this conclusion in the future.

Abbreviations: 95% CI = 95% confidence interval, GI = gingival index, NOS = Newcastle-Ottawa Scale, OR = odds ratio, PLI = plaque index, RCT = randomized controlled trial, SBI = sulcus bleeding index, SPD = sulcus probing depth.

Keywords: fixed appliances, invisalign, meta-analysis., orthodontic, periodontal health status

1. Introduction

At present, with the development of medical technology and the improvement of people's living standard, people pay more and more attention to the appearance of their periodontal health status. Up to now, fixed orthodontic treatment is still the best choice for the various types of malocclusions.[1] Traditional metal stents are often recommended for patients with severe occlusion or corrective problems. Although the efficacy of the traditional braces has been recognized all over the world, it still has some disadvantages. For example, wearing a traditional braces will make people feel uncomfortable, and it is difficult to conventional cleaning. Patients must carefully brush each bracket and floss around the wires to remove all traces of plaque, in order to reduce the risk of demineralization during this treatment.[2] In addition, Yáñez-Vico et al[3] found that regular adjustments can be uncomfortable and inconvenient, which will seriously hampers proper oral hygiene, creates numerous plaque retention sites and then potentially leading to develop white spot lesions, caries, and periodontitis. Some previous studies have found that treating with fixed orthodontic appliances will stimulate the growth of a subgingival plaque, thus leading to some adverse effects, and then increase the discomfort of those patient.[4–6] Therefore, using an alternative removable orthodontic appliances may allow those patients to maintain an adequate oral hygiene, and then reduce the risk for negative dental and periodontal complications.[6–8]

The Invisalign system (Align Technology, Santa Clara, CA), a new generation of removable, clear semi elastic polyurethane

Editor: Giovanni Tarantino.

Funding: This study was supported by the Affiliated Stomatological Hospital of Guangxi Medical University.

The authors have no conflicts of interest to disclose.

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Medicine (2018) 97:13(e0248)

Received: 24 October 2017 / Received in final form: 1 March 2018 / Accepted: 6 March 2018

http://dx.doi.org/10.1097/MD.0000000000010248

Systematic Review

Periodontal health during orthodontic treatment with clear aligners and fixed appliances

A meta-analysis

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Supplemental material is available online.

ABSTRACT

Background. Clear aligners have become increasingly popular because of their esthetics and comfort. The authors' aim in this systematic review was to compare periodontal health in patients undergoing orthodontic treatment with clear aligners with that of those undergoing orthodontic treatment with fixed appliances.

Types of Studies Reviewed. The authors systematically searched the PubMed, Web of Science, Cochrane Library, and Embase databases to collect related studies. After extracting data and assessing quality, the authors performed a meta-analysis and trial sequential analysis. The authors used the Grading of Recommendations Assessment, Development and Evaluation system to assess the quality of the evidence.

Results. The authors included 9 studies in the quantitative synthesis analysis. Clear aligners were better for periodontal health, including plaque index (mean difference [MD], −0.53; 95% confidence interval [CI], −0.85 to −0.20; $P = .001$), gingival index (MD, −0.27; 95% CI, −0.37 to −0.17; $P < .001$), and probing depth (MD, −0.35; 95% CI, −0.67 to −0.03; $P = .03$), than were fixed appliances. However, the trial sequential analysis outcome indicated a false-positive meta-analysis result for probing depth. The authors downgraded the level of the evidence because of the risk of bias and inconsistency.

Conclusions and Practical Implications. Clear aligners were better for periodontal health than fixed appliances and might be recommended for patients at high risk of developing gingivitis. However, high-quality studies still are required.

Key Words. Gingivitis; orthodontic appliances; literature review.

JADA 2018:149(8):712-720
https://doi.org/10.1016/j.adaj.2018.04.010

The demand for orthodontic treatment has increased in both adult and young patients.[1,2] Fixed appliances are the most common and traditional treatment method used in contemporary orthodontics.[3] However, the placement of orthodontic brackets and bands usually makes proper plaque removal more challenging. The increases in food deposits and dental plaque often lead to enamel demineralization and gingival inflammation if patients cannot maintain good oral hygiene.[4-6] In contrast, clear aligners have had advantages such as esthetics, comfort,[7,8] and convenience for oral hygiene because they are removable.[9]

Clear aligners, which have been available since 1999,[9] have become increasingly popular.[10] Clinicians have considered them to be safe, esthetic, and comfortable orthodontic appliances for patients.[11] The advantage of clear aligners over traditional fixed appliances on periodontal conditions, however, is still under debate. Investigators have reported that clear aligners allowed adequate oral hygiene and reduced the risk of developing negative periodontal complications compared with fixed appliances.[12,13] Investigators in other studies have found that

This article has an accompanying online continuing education activity available at: http://jada.ada.org/ce/home.

ORIGINAL ARTICLE

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Periodontal condition of the mandibular anterior dentition in patients with conventional and self-ligating brackets

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Dates:
Accepted 31 July 2008

To cite this article:
Pandis N, Vlachopoulos K, Polychronopoulou A, Madianos P, Eliades T:
Periodontal condition of the mandibular anterior dentition in patients with conventional and self-ligating brackets
Orthod Craniofac Res 2008;**11**:211–215

Structured Abstract

Authors – Pandis N, Vlachopoulos K, Polychronopoulou A, Madianos P, Eliades T

Objectives – To explore whether the use of self-ligating brackets is associated with better values for periodontal indices because of the lack of elastomeric modules and concomitantly, reduced availability of retentive sites for microbial colonization and plaque accumulation.

Setting and Sample Population – Private practice of the first author. Patients were selected using the following inclusion criteria: age range 12–17 years, fixed appliances on both arches, aligned mandibular arch, and absence of oral habits and anterior crossbites.

Materials and Methods – Prospective cohort investigation. Participants were grouped for bracket type, thus 50 patients formed the conventional bracket cohort and 50 patients the self-ligating bracket cohort. Both cohorts were followed with the purpose to examine periodontal status. Average length of follow-up was 18 months. This time period was considered adequate for a proportion of study participants to experience the outcome of interest. Outcome variables were plaque index, gingival index, calculus index, and probing depth for the two bracket cohorts.

Results – No difference was found in the indices recorded between the two bracket cohorts studied.

Conclusion – Under the conditions as applied in this study, the self-ligating brackets do not have an advantage over conventional brackets with respect to the periodontal status of the mandibular anterior teeth.

Key words: orthodontic appliances; orthodontics; periodontal indices; periodontium; self-ligating brackets

Introduction

One of the proposed favorable aspects of self-ligating brackets is associated with the elimination of elastomeric or stainless steel ligatures. This feature brings two basic advantages: the eradication of the cross-contamination, which may accidentally be involved in the process of ligature handling and

ORIGINAL ARTICLE

Periodontal pathogen levels in adolescents before, during, and after fixed orthodontic appliance therapy

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Introduction: This purpose of this study was to document and investigate changes in periodontal pathogen levels before, during, and after orthodontic treatment in adolescents. **Methods:** DNA gene probe analysis was used to quantify the levels of 8 periodontal pathogens before, during, and after treatment with fixed orthodontic appliances in 190 concurrently treated adolescent orthodontic patients. The 8 pathogens examined were *Actinobacillus actinomycetemcomitans* (AA), *Porphyromonas gingivalis* (PG), *Prevotella intermedia* (PI), *Tannerella forsythia* (TF), *Eikenella corrodens* (EC), *Fusobacterium nucleatum* (FN), *Treponema denticola* (TD), and *Campylobacter rectus* (CR). Chi-square tests were used to determine whether the percentages of subjects with high counts significantly changed over time. Logistic regression analyses were also performed to derive the relative risk of higher counts of pathogenic bacteria with fixed appliances at the various time intervals studied. **Results:** For 6 (PI, TF, EC, FN, TD, CR) of the 8 pathogens, the percentages of subjects with high pathogen counts increased significantly after 6 months of fixed appliance treatment, but these returned to pretreatment levels by 12 months of orthodontic treatment. No pathogen level was significantly higher after 12 months of orthodontic treatment, and orthodontic treatment was found to be significantly protective for half of the pathogens (EC, FN, TD, CR) posttreatment. **Conclusions:** Orthodontic treatment with fixed appliances does not increase the risk of high levels of these periodontal pathogens. (Am J Orthod Dentofacial Orthop 2009;135:95-8)

Basic science advances have made possible the transfer of technologically advanced diagnostic decision-making methods from the laboratory to the dental office. Clinical dentistry has yet to take full advantage of these advances or their diagnostic possibilities. Oral conditions such as periodontal diseases[1] can be diagnosed and evaluated with greater precision.[2] Various bacteria, particularly certain anaerobic strains, have been associated with periodontal diseases for decades.[3-8] In addition, the detection of putative periodontal pathogens in subgingival specimens by DNA amplification has been developed for both suspect anaerobic species and their various strains.[9]

Few studies have been conducted on the bacterial flora of early onset periodontitis or juvenile patients. A study by Albander et al[10] used the OmniGene probe to analyze detectable levels of red group bacteria or bacteria commonly associated with the etiology of periodontitis over 6 years. Bacterial strains of interest included *Porphyromonas gingivalis* (PG), *Prevotella intermedia* (PI), *Fusobacterium nucleatum* (FN), *Campylobacter rectus* (CR), and *Treponema denticola* (TD). It was concluded that patients with early onset periodontitis had greater percentages of bacteria than did the control groups. This study is one of the few long-term bacterial analyses of juvenile patients.[3]

Studies have shown that loss of attachment and supporting bone of at least 1 site are seen in 1% to 9% of patients 5 to 11 years old and in 1% to 46% of those 12 to 15 years old.[8,11] Epidemiologic studies clearly indicate that destructive forms of periodontal disease can occur in children and adolescents.[4,6] Investigating the potential for disease in these patients during orthodontic treatment would be beneficial, because fixed

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Submitted, December 2005; revised and accepted, February 2007.
0889-5406/$36.00

doi:10.1016/j.ajodo.2007.02.057

Effect of orthodontic treatment on the subgingival microbiota: A systematic review and meta-analysis

Papageorgiou, Spyridon N ; Xavier, Guilherme M ; Cobourne, Martyn T ; Eliades, Theodore

Abstract: The aim of this systematic review was to assess qualitative changes induced by fixed appliance orthodontic treatment on the subgingival microbiota. Seven databases were searched up to August 2017 for randomized and nonrandomized clinical studies assessing the effect of orthodontic appliances on the subgingival bacteria in human patients. After elimination of duplicate studies, data extraction and risk of bias assessment according to the Cochrane guidelines, random-effects meta-analyses of relative risks (RR) and their 95% confidence intervals (CIs) were performed. According to controlled studies, the presence of Aggregatibacter actinomycetemcomitans in the subgingival crevicular fluid of orthodontic patients was increased 3-6 months after fixed appliance insertion compared to untreated patients (2 studies; RR = 15.54; 95% CI = 3.19-75.85). There was still increased subgingival prevalence of Aggregatibacter actinomycetemcomitans (3 studies; RR = 3.98; 95% CI = 1.23-12.89) and Tannerella forsythia in orthodontic patients up to 6 months after appliance removal compared to untreated patients. However, caution is warranted due to high risk of bias and imprecision. Insertion of orthodontic fixed appliances seems to be associated with a qualitative change of subgingival microbiota, which reverts to some extent back to normal in the first months after appliance removal. However, there is limited evidence on the timing and extent of these changes.

DOI: https://doi.org/10.1111/ocr.12237

Originally published at:
Papageorgiou, Spyridon N; Xavier, Guilherme M; Cobourne, Martyn T; Eliades, Theodore (2018). Effect of orthodontic treatment on the subgingival microbiota: A systematic review and meta-analysis. Orthodontics craniofacial research, 21(4):175-185.
DOI: https://doi.org/10.1111/ocr.12237

PLOS ONE

RESEARCH ARTICLE

Profiling of subgingival plaque biofilm microbiota in adolescents after completion of orthodontic therapy

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OPEN ACCESS

Citation: Pan S, Liu Y, Zhang L, Li S, Zhang Y, Liu J, et al. (2017) Profiling of subgingival plaque biofilm microbiota in adolescents after completion of orthodontic therapy. PLoS ONE 12(2): e0171550. doi:10.1371/journal.pone.0171550

Editor: David M. Ojcius, University of the Pacific, UNITED STATES

Received: October 5, 2016

Accepted: January 23, 2017

Published: February 3, 2017

Data Availability Statement: All relevant data are within the paper.

Funding: This work was supported by the Enterprise Innovation program of Jinan Science and Technology Bureau (no. 201201057) and the National Science Foundation of China (no. 81271140). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors declare no conflict of interest.

Abstract

Background

Fixed orthodontic treatment is the most common method for malocclusion but has the potential risk of periodontal complication with unclear outcomes of whether microbiologic and clinical changes could be reversible in adolescents after orthodontic therapy.

Methods

Twenty adolescents with orthodontic treatment were enrolled in the study as the case group at end of the therapy, while 19 periodontally healthy adolescents were involved in the control group. At baseline (T_0), clinical parameters including gingival index, probing depth and sulcus bleeding index were tested, and subgingival plaque samples were collected from the lower incisors. The counts of *A. actinomycetemcomitans*, *P. gingivalis*, *P. intermedia*, *T. forsythia* and total bacteria were determined by real-time PCR. All parameters were reassessed after 1 month (T_1) and 3 months (T_2) in the case group and compared with that of the controls.

Results

At baseline (T_0), clinical parameters (including GI, PD, SBI) of the test sites in the case group were significantly higher than that of the control group ($P<0.05$ or $P<0.01$). At 3 months (T_2), no differences were noticed in GI and SBI between two groups. The prevalence and counts of periodontopathogens tend to be normal ($P>0.05$), while PD and the amount of *P.intermedia* were still significantly higher compared with that of the control group ($P<0.05$ or $P<0.01$).

Conclusion

After removal of appliances, the periodontal changes induced by orthodontic therapy are only partially reversible at 3 months after removal.

Journal of Orofacial Orthopedics
Fortschritte der Kieferorthopädie

Original Article

Halitosis, Oral Health and Quality of Life during Treatment with Invisalign® and the Effect of a Low-dose Chlorhexidine Solution

Halitosis, Mundgesundheit und Lebensqualität während der Invisalign®-Therapie und der Einfluss einer Chlorhexidin-Mundspüllösung

Isabelle Schaefer, Bert Braumann[1]

Abstract

Aim: This study examined how halitosis, oral dryness and general oral health were impacted during treatment with the Invisalign® system. Furthermore, the effect of a low-dose chlorhexidine solution (CHX) was evaluated.

Patients and Methods: Thirtyone patients with good periodontal health participated in this crossover study and were divided into two groups (group 1: CHX/no CHX, group 2: no CHX/CHX). The following parameters were recorded during the first 8 months of Invisalign® treatment: stimulated saliva flow rate, organoleptic index, tongue coating index, measurement of the oral volatile sulfur compound level (ppb), modified gingival and plaque index and bleeding on probing index. Professional oral cleaning was performed at the beginning of each period lasting 3 months. The patients received a questionnaire at the first, third, fourth, sixth and eighth control visits.

Results: The very low volatile sulfur compound level was significantly decreased by CHX (0.06%) during the first examination period ($p = 0.02$), i.e. for the first group of patients only. Neither halitosis, nor oral dryness, nor high plaque or gingival index measurements were observed. Oral health-related quality of life was hardly influenced by wearing aligners and oral hygiene habits were very good.

Conclusions: This study provides evidence that Invisalign® treatment is characterized by only minimal impairment of overall oral health and the associated quality of life. Consequently, it appears unnecessary to recommend the general

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Received: September 5, 2010; accepted: September 30, 2010

Zusammenfassung

Ziel: Es sollte untersucht werden, ob sich während einer Behandlung mit Invisalign® das anekdotisch geschilderte subjektive Vorhandensein von Halitosis oder Mundtrockenheit objektivieren lässt und inwieweit sich die Mundgesundheit und die Lebensqualität im Therapieverlauf verändern. Zusätzlich wurde der Einfluss einer niedrig dosierten Chlorhexidin-Mundspüllösung (CHX) ermittelt.

Patienten und Methodik: Es wurden 31 parodontal gesunde Probanden in diese Cross-Over-Studie aufgenommen und in zwei Gruppen aufgeteilt (Gruppe 1: CHX/kein CHX, Gruppe 2: kein CHX/CHX). Zu acht Untersuchungszeitpunkten während der ersten 8 Monate der Invisalign®-Behandlung erfolgte die Erhebung folgender Parameter: stimulierte Speichelfließrate, organoleptischer Index, Zungenbelagsindex, Messung der oralen flüchtigen Schwefelverbindungen (ppb), modifizierter Gingiva-Index, modifizierter Plaque-Index und Bleeding on Probing Index. Zu Beginn der beiden 3-monatigen Untersuchungsperioden erfolgte zudem eine professionelle Zahnreinigung. Die Fragebögen wurden am ersten, dritten, vierten, sechsten und achten Kontrolltermin beantwortet.

Ergebnisse: Durch die 0,06%ige Chlorhexidin-Gabe konnte eine statistisch signifikante Reduktion der sehr niedrigen Werte der flüchtigen Schwefelverbindungen während der ersten Periode ($p = 0,02$), also nur bei der ersten Gruppe, festgestellt werden. Bei den untersuchten Patienten wurden weder Halitosis, noch Mundtrockenheit, noch erhöhte Plaque- oder Entzündungswerte beobachtet. Die mundgesundheitsbezogene Lebensqualität wurde durch das Tragen der Aligner kaum beeinflusst. Die Mundhygieneangewohnheiten waren sehr gut.

J Orofac Orthop 2010;71:430–41
DOI 10.1007/s00056-010-1040-6