Universidad Europea

TRABAJO FIN DE GRADO

Grado en odontología

USO DE MINI PLACAS PARA EL CONTROL VERTICAL EN TRATAMIENTOS DE ORTODONCIA NO QUIRÚRGICOS

Madrid, curso 2020/2021

Número identificativo: 95

RESUMEN

Objetivos: Esta revisión bibliográfica tiene como objetivo analizar los principales cambios cefalométricos ocurridos después de una intrusión molar mediante TADs, para el cierre de la mordida abierta y estudiar si se produce recidivas.

Metodología: Se realizó esta revisión haciendo una búsqueda de artículos en bases de datos como PubMed y Medline, así como en American Journal of Orthodontic y Journal of Clinical Orthodontic. Se utilizaron las siguientes palabras claves**:** "mini placa en ortodoncia", "intrusión de molares mediante mini placa", "anclajes esqueléticos temporales", "corrección de mordida abierta mediante mini placa".

Resultados: En una revisión inicial se encontraron 173 artículos en revista de impacto. 30 fueron descartados por ser estudio sobre anclaje osteointegrados, 70 han sido excluido por tratar de movimiento de distalización o mezalización, y 10 han sido apartados por ser artículos realizado sobre paciente con enfermedad sistémica. Además, se han retirado 5 por tener muestra en vivo, así como 10 por tener una fecha anterior a 2002.

Por otro lado, se han incluido 48 artículos en el alcance de esta revisión respectando los criterios de inclusión haciendo referencia a nuestros objetivos. De los 48 artículos, 4 fueron meta análisis, 1 libro, 39 de revisiones y 4 casos clínicos, todos ellos respondían a nuestro proyecto.

Conclusiones: Las mini placas utilizadas para una intrusión molar, producen diferentes cambios cefalométricos, tanto dentales como esqueléticos. Resultando un medio eficaz para corregir la mordida abierta a pesar de tener una recidiva casi sistemática.

ABSTRACT

Objectives: The objective of this bibliographic review is to analyze the main cephalometric changes that occurred after a molar intrusion using TADs, for the closure of the open bite and investigate if any relapse occurred.

Methodology: This review was taken from articles in databases such as PubMed and Medline, as well as in the American Journal of Orthodontic and the Journal of Clinical Orthodontic. The following key words were used: “mini plate in orthodontic”, “intrusion of molars with mini plates”, “temporary skeletal anchors”, “correction of the open bite with mini plates”.

Results: In an initial review, 173 articles were found in impacts journals. 30 were discarded because they were studying osteointegrated anchorage, 70 were excluded because they were doing a distalizing or mesializing movement, and 10 were excluded because they were articles on a patient with systemic disease. In addition, 5 have been withdrawn for having animal sample, as well as 10 because they were published before 2002.

On the other hand, 48 articles have been included to realize this review, respecting the inclusion criteria, referring to both our objectives.

4 of 48 articles was meta-analysis, 40 journal, 4 clinic cases that respond to our project.

Conclusions: Mini plates used for molar intrusion produce different cephalometric changes, dental or skeletal. This is an effective way to correct the open bite despite having a relapse nearly systematic.

INDÍCE

1. INTRODUCCIÓN

La mordida abierta se refiere a la falta de contacto evidente entre los dientes superiores e inferiores, manifestándose a nivel del grupo incisivo o de los segmentos posteriores de las arcadas[1].

La mordida abierta anterior trata de una maloclusión, con prevalencia del 3,5%, que produce un defecto de contacto anterior debido a un problema dental o esquelético [2].

La mordida abierta esquelética se encuentra dentro de los casos más difíciles de tratar debido a una etiología multifactorial y con una tasa de recidiva alta [3].

En un paciente con mordida abierta sin crecimiento, se realiza la corrección mediante la intrusión de los dientes posteriores o extrusión de los dientes anteriores, según el caso. La intrusión de los molares se puede realizar mediante las mini placas [4].

La definición de un anclaje es "todo medio destinado a asegurar una estabilidad de un diente o grupo de dientes durante un movimiento provocado que interese a otro diente" [5],[6]. La gestión del anclaje durante un tratamiento ortodóntico es todo un reto. Las condiciones individuales de cada paciente, así como los problemas periodontales y la ausencia de dientes, pueden ser factores condicionantes de los anclajes. Actualmente, existen varios tipos de anclajes esqueléticos en ortodoncia, entre ellos el anclaje esquelético temporal no osteointegrado que incluye las minis-placas [7]. Estas placas se insertan directamente en el hueso mediante una pequeña cirugía [7].

Jensen ha hablado por primera vez de estas placas en el año 1985, inicialmente las mini placas se utilizaban para distalizar los molares [5].

En el año 1999, Sugawara ha utilizado estas placas para corregir la mordida abierta ingresando los molares, desplazamiento dentario considerado antiguamente como imposible (intrusión de molares maxilares o distalización de molares mandibulares) [8],[9].

Las mini placas se utilizan para la corrección de la mordida abierta mediante un tratamiento que consiste en la intrusión de los molares. Se colocan en adultos, pacientes sin crecimiento con dentición permanente [10],[9], pero también se pueden colocar en niños [11], teniendo en cuenta la imposibilidad de su colocación antes de la erupción de los caninos, debido a la altura del hueso sobre todo en una placa mandibular [12].

1.1. Diseño de la placa

Las mini placas fabricadas con Titanio o aleaciones del mismo, están compuestas de 3 partes, la cabeza, el brazo y el cuerpo, así como de 2 ó 3 tornillos para su fijación [13].

Así mismo, dichas placas pueden presentar diferentes formas: Y, T, I o L. La forma en L y en T se encuentran en general en la mandíbula, teniendo en cuenta los límites del foramen mentoniano [14], mientras que la forma en Y, T o I se ubican más frecuentemente en el maxilar superior debido al hueso cortical, evitando con prudencia el sinus [5],[14]. Las placas en L o en T están formadas por un cuerpo horizontal mientras que la placa en I está formada por un

cuerpo vertical [14]. La forma se elige dependiendo del lugar de inserción y de las exigencias clínicas [14].

La elección del tipo de placa (T, I, Y o L) y de su longitud depende del lugar de inserción, de la densidad de hueso (2 o 3 tornillos), la profundidad del vestíbulo [14], así como de la longitud y de la posición de las raíces de los dientes adyacentes [5].

Figura 1: Placa en T para la intrusión de los molares superiores [15].

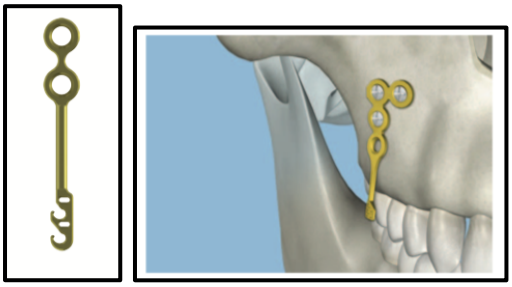


Figura 2: Placa en I y L para la intrusión de los molares [15].

En un mismo paciente se pueden insertar dos mini placas [3].

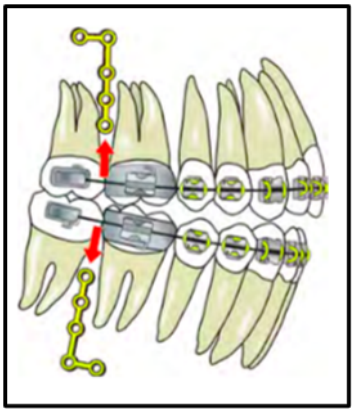


Figura 3: Dos minis placas para realizar intrusión de molares [5].

1.2. Ventajas del uso de las mini placas con respecto a otros tipos de tratamientos

Respecto a la ortodoncia tradicional:

En comparación con la ortodoncia tradicional, las mini placas no dependen de la colaboración del paciente [9] y se pueden aplicar diferentes fuerzas variables, más elevadas en diferentes direcciones, evitando que existan movimientos no deseados, por ejemplo, la extrusión de los dientes anteriores. Gracias a la invención de las mini placas, el tratamiento es más simple, más previsible y más corto, pudiendo evitarse ciertas cirugías en muchos casos [5],[7].

La tasa de éxito de las mini placas es muy alta y predecible (98,6%) para una amplia gama de movimientos ortodónticos complejos [16].

Sherwood 2007 se ha centrado en la descripción de importantes reabsorciones ubicadas a la altura de los incisivos, pero no ha sido considerado como significativo en comparación a un tratamiento ortodóntico convencional [10].

Respecto a los mini implantes:

En comparación a los mini implantes, según Erverdi las mini placas son más estables y más fiables [7]. Según Sakima Tatsuei, los mini implantes permiten fuerzas inferiores en comparación a las mini placas [4]. Por otro lado, algunos autores como Cornelis o Miyawaki, definen que una razón por la que se utilizan los mini implantes en lugar de las mini placas es por la cantidad de sobre crecimiento de los tejidos blandos, producida alrededor de la mini placa debido a la acumulación de placa, la cual provoca inflamación [17],[18],[19].

Se puede insertar en hueso alveolar y en hueso basal [12]. Las mini placas poseen una tasación de éxito muy elevada, con rango entre el 91,4% y el 100%, así mismo comprenden un bajo grado de mortalidad [20]. En un estudio llevado a cabo por Cornelis, se ha considerado una valoración de éxito del 92,5% [18]. En cambio, según el análisis de Takaki en el año 2010, que se ha realizado en Tokyo con 444 mini placas, se ha podido verificar su baja valoración de fallo que está comprendida entre el 2,8% y el 7,3% [21].

Según el movimiento que se desea realizar, el sitio de inserción de la mini placa es primordial. Los tornillos de fijación en las mismas se colocan apicalmente de las raíces para no interferir en los movimientos dentarios radiculares [18],[12].

Respecto a la cirugía:

El coste de la colocación de las mini placas es inferior al de la cirugía ortognática. Además, la inserción necesita anestesia local, mientras que una cirugía ortognática necesita anestesia general [12].

Respecto a los mini tornillos:

La tasa de éxito mediante mini placas es significativamente más alta que mediante mini tornillos debido a su inserción en el cigomático o en la mandíbula cuando existe un alta densidad de hueso [13]. Además, las mini placas tienen mayor estabilidad debido a la fijación de varios tornillos [22] y puede resistir frente a fuerzas mayores [23].

Seres argumenta en su estudio acerca de los riesgos de reabsorciones radiculares, analizando la vitalidad de los dientes que hayan sufrido una intrusión y no ha detectado reabsorciones significativas [24].

1.3. Desventajas del uso de las mini placas

Cirugía:

Uno de los mayores inconvenientes de las mini placas es la necesidad de realizar dos cirugías, una para insertar la mini placa al inicio del tratamiento y otra para extraerla al final del tratamiento [12].

Coste:

Las inserciones de las mini placas son más costosas que la colocación de los mini tornillos [25].

Aplicación de fuerzas:

En el instante de la instalación no se pueden efectuar fuerzas de intrusión directamente en los molares ya que, se necesita una cicatrización de al menos dos semanas antes de iniciar el mecanismo de acción [10], aunque Erverdi aconseja aguardar incluso hasta dos meses [7].

Complicaciones:

Otro de los inconvenientes redactado por Cornelis, trata de la colocación de 200 mini placas, de las que se han tenido que eliminar cincuenta de ellas de forma temprana. Esto se debe a que los pacientes han sufrido una inflamación importante al cabo de 5,3 días de media después de su colocación y de 4,5 días de media después de su remoción. Sobre las cincuentas mini placas retiradas, tres de ellas han sufrido un sobre crecimiento de hueso [(18)].

Existe una posible infección de hueso (21,1%) tras un movimiento de intrusión molar cuando la higiene es escasa [(16)].

1.4. Contraindicaciones de la colocación de las mini placas

Las contraindicaciones en la inserción de una mini placa son comunes en los actos cirúrgicos. Está prohibida su colocación en los pacientes que presentan irradiaciones cérvico-facial o con un alto riesgo de endocarditis infecciosa. Además, tiene que evitarse en los pacientes inmunodeprimidos o insulinos dependientes no controlados. Se han de tener en cuenta algunos factores como el consumo de tabaco, así como la diabetes, ya que pueden provocar una mala cicatrización, e incluso una reabsorción ósea [(26),(27)].

Para la utilización de las mini placas es necesaria una buena salud periodontal [(10)].

1.5. Localización anatómica de las mini placas

A la hora de tratar una mordida abierta, se lleva a cabo, entre otros, un movimiento de intrusión en los molares. Las mini placas se pueden insertar en diferentes lugares, siendo

recomendado, por ejemplo, en el maxilar superior la cresta cigomática [4],[9],[12] y en la mandíbula su cuerpo, debido a que son estructuras sólidas [4].

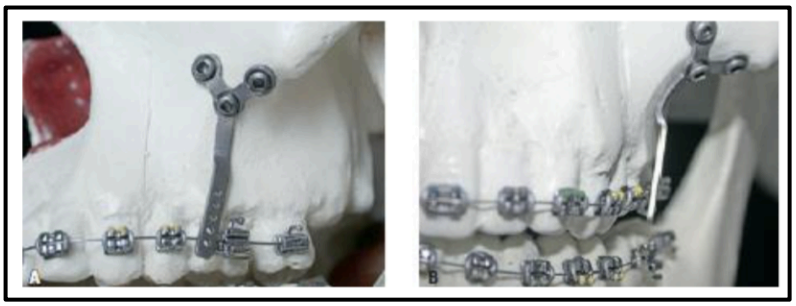


Figura 4: Anclaje en la cresta cigomática [4].

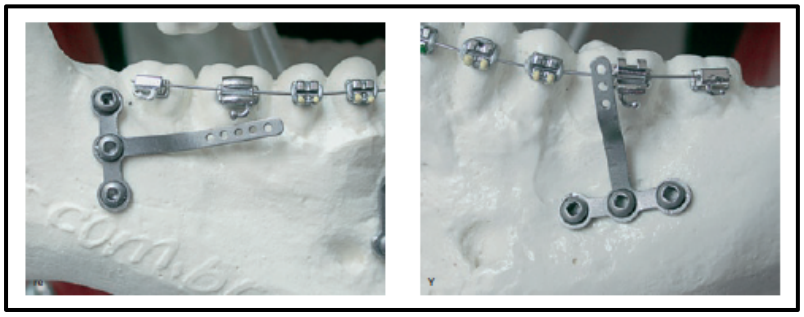


Figura 5: Anclaje en el cuerpo de la mandíbula [4].

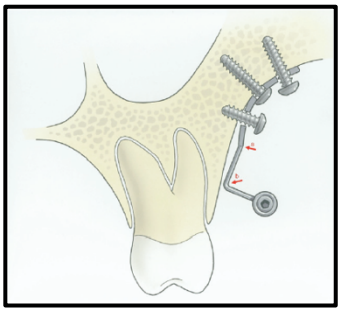


Figura 6: Sección transversal de la inserción de una mini placa en la cresta cigomática [18].

1.6. Análisis antes de la colocación de las mini placas

Para realizar un diagnóstico correcto de una maloclusión se deben llevar a cabo estudios cefalométricos. La cefalometría es una técnica que permite realizar mediciones del cráneo, la cara, los maxilares tanto superiores como inferiores, así como la posición dentaria sobre telerradiografías de perfil, en general del lado derecho [(1)].

Desde el punto de vista clínico, la técnica de la cefalometría se emplea para valorar y comparar las relaciones espaciales del complejo cráneo facial. La validez y la fiabilidad de los datos dependen de la precisión de los puntos, respectando los principios que regulan la radiología donde la orientación, distorsión y magnificación deben ser disminuidos para que los resultados sean fiables [(1)].

La aplicación del análisis permite al profesional realizar el diagnóstico. El objetivo es precisar la localización exacta de los puntos según las estructuras anatómicas que los definen, así como saber si el origen de la mordida abierta es un problema de hueso o dentario. También permite conocer la dirección del crecimiento de la cara y ayuda a dictar el pronóstico para la corrección ortodóntica [(1)].

Los diferentes análisis cefalométricos tienen diferentes puntos, líneas y planos de referencias con valores angulares y lineales. Permitiendo establecer el tipo facial del paciente, es decir, si es indicada la corrección de la mordida abierta mediante una intrusión molar [(1)].

La cefalometría permite medir y evaluar lo que ha ocurrido durante el tratamiento. Si el cierre de la mordida abierta tiene como origen la intrusión molar y/o una extrusión incisal, permite precisar lo que ha ocurrido realmente [(1)].

Sobre el análisis posicional, en la cefalometría actual, se utilizan los ángulos SNA y SNB que proporcionan las relaciones posicionales de los maxilares basándose en el plano de referencia craneal [(1)].

En la siguiente figura, se pueden apreciar las medidas cefalométricas esqueléticas [(28),(29)]:

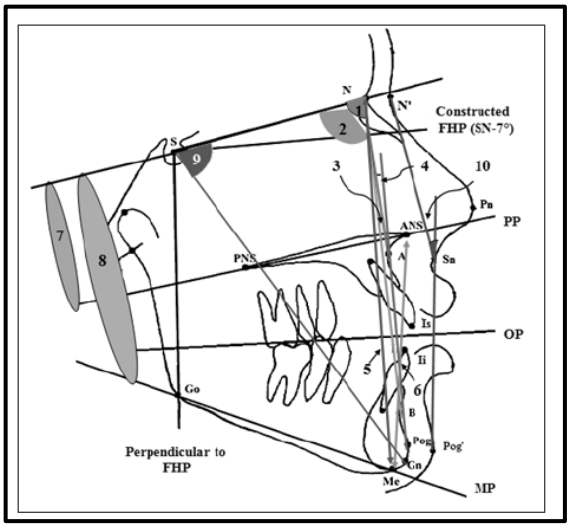


Figura 7: Trazado cefalométrico con medidas esqueléticas [(28)].

1 SNA (°): Posición antero posterior de la base del maxilar y la base craneal anterior (SN).

2 SNB (°): Posición antero posterior de la base de la mandíbula y la base craneal anterior (SN).

5 N-Me (mm): La altura total anterior entre el nasion (N) y el punto mentón (Me).

6 ANS-Me (mm): Altura facial anterior entre la espina nasal anterior (ANS) y el mentón (Me).

7 SN-PP (°): Ángulo del plano palatino es el ángulo entre el plano palatino (PP) y la base anterior del cráneo (SN).

8 MP-SN (°): Es el ángulo entre el plano mandibular (MP) y la base anterior del cráneo (SN).

9 SN-GN (°): Es el ángulo entre la base anterior del cráneo (SN) y el Gnation (GN).

En la siguiente figura, se pueden apreciar las medidas cefalométricas dentarias [28],[29]:

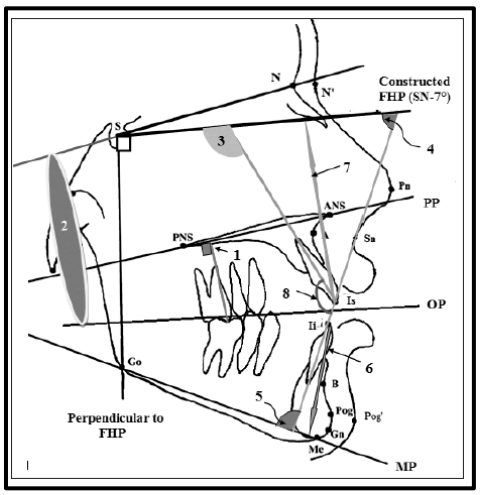


Figura 8: Trazado cefalométrico con medidas dentarias [28].

1 U6-PP (mm): La altura dentoalveolar del maxilar posterior, se trata de la distancia perpendicular entre la cúspide mesio-vestibular del primer molar superior (U6) y del plano palatino (PP).

2 SN-OP (°): Ángulo entre el plano oclusal (OP) y la base craneal anterior (SN).

8 Ángulo interincisivo (°): Ángulo anterior entre el eje del incisivo central superior y el eje del incisivo central inferior.

En la siguiente figura, se pueden apreciar las medidas cefalométricas del resalte y de la mordida abierta [28],[29]:

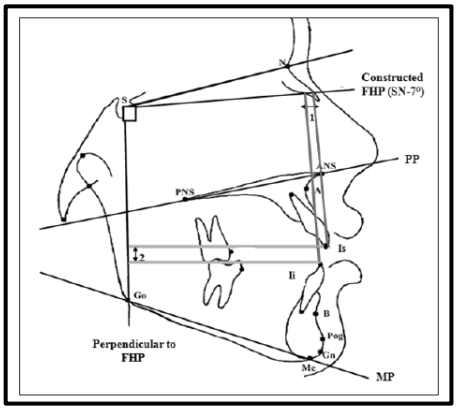


Figura 9: Medidas de la mordida abierta y el resalte [28].

1 El resalte (mm): Distancia horizontal entre la parte vestibular del incisivo inferior y la cara palatina del incisivo superior.

2 Mordida abierta (mm): Es la distancia vertical entre el borde de los incisivos superiores (Is) y el borde de los incisivos inferiores con la perpendicular al plano de referencia vertical (VP).

Antes de proceder a la inserción de la mini placa, se ha de efectuar un estudio cefalométrico para diagnosticar las causas de la mordida abierta, esqueléticas o dentales. Se ha de realizar una evaluación clínica exhaustiva, exploraciones extraorales e intraorales, así como realizar radiografías panorámicas o tomografía, fundamentales para analizar la calidad y la cantidad de hueso cortical debido a que son factores que influyen en el suceso del anclaje [5].

1.7. Definición de Temporal Anchorage Devices (TADs)

Los TADs tienen como significado "Temporal Anchorage Devices", estos incluyen las mini placas así como los mini tornillos e implantes [13],[14]. Se trata de un dispositivo que se fija de manera temporal en el hueso para ser eliminado al final de su utilización. La evolución de los TADs está basada sobre la mejora del anclaje tradicional ortodóntico, implante dental y método de fijación ortognátia [30].

Hoy en día, varios tipos de maloclusiones pueden ser tratadas con los TADs. Los TADs proporcionan un anclaje esquelético, permitiendo el desplazamiento de los dientes en todas las direcciones [31].

Figura 10: Mini tornillo utilizado para una intrusión molar [14].

2. OBJETIVOS

Los objetivos segundarios de este trabajo son:

1. Definir los principales cambios cefalométricos a nivel dentario que han ocurrido después de la corrección de la mordida abierta tras la intrusión molar mediante TADs.

2. Definir los principales cambios cefalométricos a nivel esqueletico que han ocurrido después de la corrección de la mordida abierta tras la intrusión molar mediante TADs.

3. Estudiar la estabilidad en el tiempo de la intrusión molar con TADs para tratar la mordida abierta y la necesidad de realizar una fase de contención.

Palabras claves: “mini placa en ortodoncia”, “intrusión de molares mediante mini placa”, “anclajes esqueléticos temporales”, “corrección de mordida abierta mediante mini placa”.

3. METODOLOGÍA

En la realización de esta revisión bibliográfica se ha llevado a cabo una búsqueda de artículos científicos de diferentes bases de datos como Pubmed, Medline y Scielo. Además, se han buscado artículos directamente en los sitios web de revisión de impacto como American Journal of Orthodonticy o Journal of Clinical Orthodontic. Dichos artículos se han encontrado en diferentes idiomas, inglés, francés, español y portugués.

Las palabras claves empleadas fueron “mini placa en ortodoncia”, “intrusión de molares mediante mini placa”, “anclajes esqueléticos temporales”, “corrección de mordida abierta mediante mini placa”.

Se establecieron una serie de criterios de inclusión y exclusión que debían tener los artículos empleados para la realización de la revisión bibliográfica.

3.1. Criterio de inclusión

Los criterios de inclusión establecidos para la selección de los artículos fueron:

- Estudios realizados en humanos.
- Los pacientes de la muestra deben estar sanos, sin patologías, anomalías dentarias o síndromes.
- Todas las muestras de los pacientes están en dentición permanente, con diferentes rangos de edad y distinto género, tanto mujeres como hombres.
- Las normas estéticas son diferentes según el país, se han preservado todas las razas.
- Se han incluido artículos publicados únicamente en revistas científicas.

- Se incluyen los artículos sobre las mini placas, así como los que abordan los anclajes esqueléticos. Los artículos tratados únicamente de mini placas son escasos, así que se ha elegido guardar aquellos documentos en los cuales se mencionan diferentes tipos de anclajes.
- En este estudio se han elegido los artículos que tratan de la intrusión molar.

3.2. Criterios de exclusión

Así mismo, los criterios de exclusión establecidos fueron:

- Todos los artículos de fechas anteriores al año 2002.
- Artículos que basaran sus estudios en implantes osteointegrados, como anclaje.
- Estudios con mini implante no oseoteointegrados como anclaje.
- Artículos que utilizan las mini placas para los movimientos de distalización y mesialización.

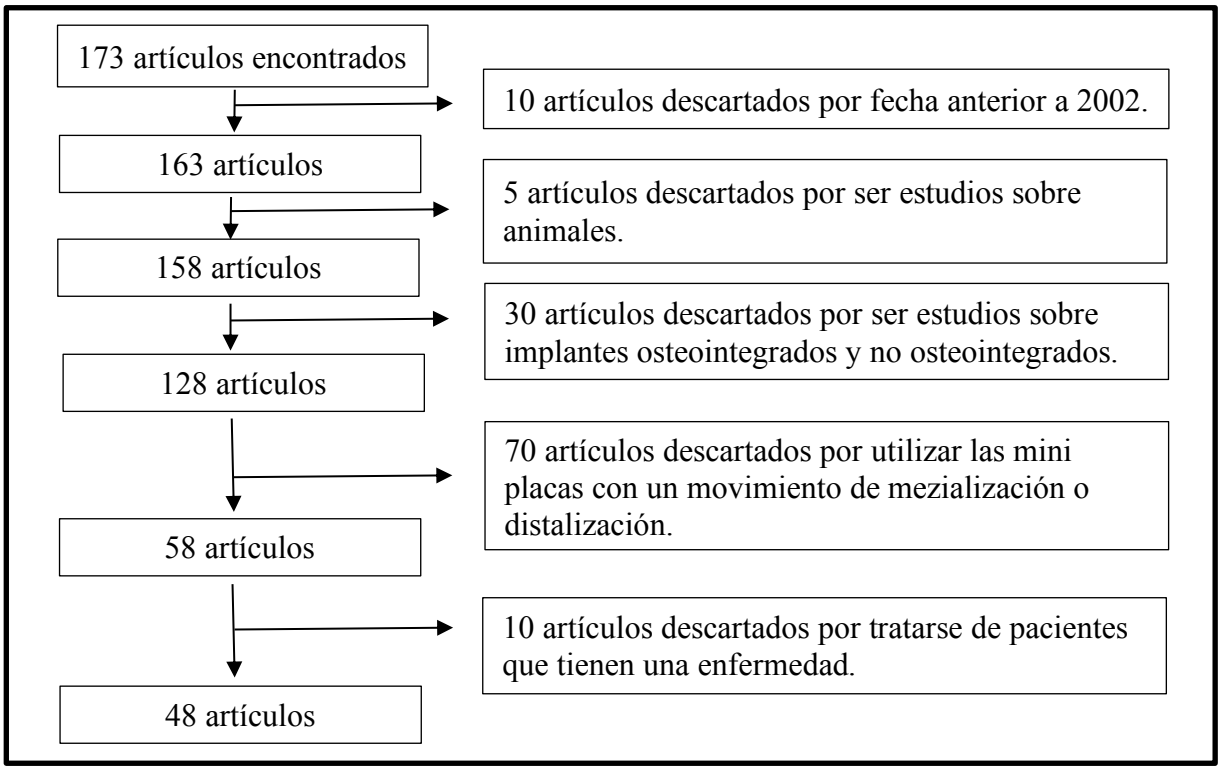


Tabla (1): Diagrama de flujo del proceso de selección de la muestra.

4. RESULTADOS

En nuestra búsqueda inicial se encontraron 173 artículos. De los artículos encontrados, en primer lugar, se descartaron 10 por ser anterior a la fecha 2002. Luego 5 fueron rechazado por ser estudios realizados en animales. Así mismo 30 fueron descartados por basarse en implantes osteointegrados y implante no osteointegrados. Posteriormente 70 fueron excluido por la utilización de las mini placas en los movimientos de distalización o mezialización. Otros 10 fueron retirados por ser estudios realizados en paciente con enfermedad sistémica. Finalmente se utilizaron 48 artículos para la realización de este trabajo.

De los 48 artículos seleccionados, 12 utilizan mini placas como anclajes y 4 utilizan diferentes TADs. También se incluyen 4 meta-análisis que responden a nuestros objetivos.

En la tabla 2, se recogen los datos del diseño de la muestra de los artículos que utilizan las mini placas como anclaje.

Así mismo, en la tabla 3, se reflejan los artículos que emplean otros tipos de TADs.

En la tabla 4, se reflejan las meta-análisis con tipo de TADs diferentes.

	Autores/año	Muestra (pacientes)			Mini placas	
		Número	Edad	Género	Forma	Ubicación
	Sugawara et al. (2002) [32]	9	13.3 - 28,9 años	7 mujeres y 2 varones	Forma en L	Cuerpo mandíbula
	Sherwood et al. (2002) [33]	4	no especificado	2 mujeres y 2 varones	Forma en L y en T	Proceso cigomático y cuerpo mandibular

	Erverdi et al. (2004) [9]	10	17-23 años	no especificado	Forma en I	Proceso cigomático del maxilar
	Erverdi et al. (2007) [34]	11	19,5 años	no especificado	Forma en I	Proceso cigomático del maxilar
	Akay et al. (2008) [41]	10	15-25 años	6 mujeres y 4 varones	mini placas	Proceso cigomático del maxilar
	Seres et al. (2009) [24]	7	15-29 años	4 mujeres y 3 varones	Forma en I	Proceso cigomático del maxilar
	Akan et al. (2013) [35]	19	13,1-25,9 años	13 mujeres y 6 varones	Forma en I	Proceso cigomático del maxilar
	Talles Fernando Medeiros de Oliveira et al. (2015) [36]	9	18.7±5.1 años	6 mujeres y 3 varones	Forma en Y y en T	Proceso cigomático del maxilar
	Marzouk et al. (2015) [28]	13	16-22años	9 mujeres y 4 varones	Forma en I	Proceso cigomático del maxilar
	Jae Hyun Park et al. (2015) [37]	1	23 años	1 varón	Forma en Y en el maxilar y T en la mandíbula	Proceso cigomático y cuerpo mandibular
	Marzouk et al. (2016) [29]	26	19-28 años	no especificado	Forma en I	Proceso cigomático del maxilar
	Dadgar et al. (2017) [3]	1	23 años	1 mujer	Forma en L	Proceso cigomático del maxilar
Total	12	120				

Tabla (2): Tabla de los artículos seleccionados con mini placas.

	Autores/año	Muestra (pacientes)			Anclaje	
		Número	Edad	Género	Tipo	Ubicación
	Lee, Park et al. (2008) [38]	*11*	18,2- 31,1 años	No especificado	Mini tornillos	Posterior sector
	Baek et al. (2010) [39]	*9*	Adultos	No especificado	Mini Tornillos	Posterior sector maxilar
	Scheffler, Profit et al. (2014) [40]	*30*	12,7-48,1 años	19 mujeres y 11 varones	Mini tornillos y mini placas	Proceso cigomático
	Garrett et al. (2016) [31]	*1*	12 años	1 mujer	TAD	Palatino temporal esquelética
Total	*4*	*51*				

Tabla (3): Tabla de los artículos seleccionados con diferentes anclajes.

	Autores/año	Anclaje	
		Tipo	Ubicación
	Hassan E kassem, Marzouk (2018) [45]	Mini placas	Posterior sector maxilar
	Alsafi et al. (2016) [46]	Mini placas (5) Mini tornillos (7)	
	Al-Dhubhani et al. (2018) [47]	Mini placas Mini tornillos	
	Daybeli et al. (2020) [48]	TADs	
Total	4		

Tabla (4): Tabla de las meta-análisis seleccionadas

5. DISCUSIÓN

Una mordida abierta anterior esquelética suele estar asociada con una altura deficiente posterior así como una excesiva altura facial anterior, una posición mandibular con un ángulo SN-PP disminuido [37].

Sherwood y Marzouk llevan a cabo un análisis sobre radiografías cefalométricas laterales. Se puede observar en el estudio de Marzouk un crecimiento vertical posterior muy importante del complejo dentoalveolar, creando una mordida abierta y mediante este análisis, se deduce si esta alteración se ubica en el maxilar o en la mandíbula [29],[33].

Se descubrió, que la mayoría de los pacientes involucrados en el estudio, manifiestan un exceso vertical posterior en los dos maxilares tanto en el superior como en el inferior. A pesar de ello, se desarrolla una única técnica, se trata de la intrusión del maxilar [33].

La mayoría de los autores elegidos en esta revisión bibliográfica coinciden en que, la principal causa de la mordida abierta esquelética es el exceso del desarrollo dentoalveolar posterior del maxilar con un plano mandibular aumentado [9]. Es por esto que el tratamiento tiene como objetivo la intrusión molar.

Los autores Sugawara y Sherwood, han realizado casos en los cuales se ubica una placa en el cuerpo de la mandíbula [32],[33]. En los estudios restantes, la ubicación de la misma se halla en el proceso cigomático [3],[9],[24],[28],[34],[35],[36].

En la mayoría de los artículos las muestras tomadas se realizan en pacientes jóvenes y adultos. Los pacientes que tienen la edad mayor, 48 años, se encuentran en la muestra de Scheffler [40].

La mayoría de los autores coinciden en la utilización de fuerzas comprendidas entre 400 y 450 gramos [34],[35], a diferencia del estudio de Seres en el cual se emplean fuerzas entre 100 y 200 gramos [24].

Según Oliveira, se pueden aplicar diferentes fuerzas en el sector posterior para la intrusión de los molares mediante mini placas, sin embargo, no existe consenso en la literatura sobre la fuerza ideal que se puede aplicar [36].

La cantidad de intrusión es relativa en función de la mordida abierta inicial. Por ejemplo, en el artículo de Marzouk, en el año 2015, considera que la cantidad de intrusión por mes ha de ser de 0,36 milímetros para alcanzar el cierre de 6,55 milímetros al finalizar el tratamiento [28].

Otros autores utilizan técnicas auxiliares asociadas al tratamiento para ayudar a la intrusión, entre otras, técnicas mecánicas como en los estudios de Akan y Erverdi. También mediante la corticotomía dando oportunidad de realizar una intrusión más importante en un tiempo menor como en el estudio de Taller Oliveira y en el de Akay [36],[41].

Los resultados del artículo de Sugawara no son comparables con los otros estudios seleccionados porque las mini placas se ubican en el cuerpo de la mandíbula y, además, los

resultados cefalométricos comparan los resultados en la fase de tratamiento y al final del mismo (recidivas), y no indica los resultados iniciales [32]. Tan sólo se utilizarían sus valores cefalométricos cuando se analiza la tasa de recidiva.

- **Cambios cefalométricos a nivel dentario.**

Las radiografías laterales han servido de base en los estudios seleccionados. Sin embargo, los errores pueden ocurrir al momento de tomar las medidas, poniendo en duda su cierta fiabilidad debido a la distorsión o la superposición de la imagen. Todos los estudios no han tenido esta cuestión en cuenta [28],[33],[36].

El análisis de Sherwood, así como el de Erverdi 2004, han utilizado una ortopantomografía con el fin de prevenir algunas superposiciones [9],[33].

Marzouk en 2015 y Erverdi en 2007, han utilizado el t-test para reducir la tasa de error, dónde han vuelto a trazar las medidas dos semanas después, retrasando 10 radiografías para asegurarse que el error es mínimo e incluso despreciable[28],[34].

Los planos de referencias para estimar la cantidad de intrusión son primordiales, así que si se producen algunas alteraciones/modificaciones durante el tratamiento podría influir sobre la apreciación de la intrusión.

En los diferentes artículos, la cantidad de intrusión viene dada por diferentes medidas. Por ejemplo, Sherwood mide la cantidad de intrusión entre la placa y la banda [33], mientras que Marzouk mide U6-PP [28],[29].

La mayoría de los estudios seleccionados, para el alcance de este proyecto, especifican los resultados cefalométricos adquiridos entre el inicio y el final del tratamiento, pero pocas veces analizan los cambios cefalométricos entre el inicio y el final de la intrusión.

A nivel molar

La intrusión de los molares superiores mediante la utilización de las mini placas produce numerosas consecuencias. Podemos pensar que la intrusión de los molares superiores podría causar una extrusión de las molares inferiores. La diferencia entre el U6-PP inicial y el final corresponde a la cantidad de intrusión del molar superior. Los autores Dadgar, Marzouk y Erverdi realizan una intrusión de 2 hasta 3 milímetros del molar superior [3],[9],[28],[34].

En la literatura de algunos estudios se ha descrito una egresión del molar antagonista mientras que en otros no se provoca esta egresión. Se constata que al ingresar el molar superior no provoca una egresión del molar inferior. La utilización de una placa acrílica utilizada de manera conjunta a una mini placa durante un movimiento de intrusión molar superior, genera una ligera intrusión de los molares inferiores [35], sin embargo, el artículo de Scheffler y Proffit no lo confirma [40].

La intrusión uni-maxilar provoca una pequeña extrusión de los molares antagonistas. Choi y Kuroda han decidido realizar una intrusión mediante mini tornillos de los molares inferiores como los superiores a la misma vez, obteniendo mayores cambios cefalométricos [43].

La intrusión simultánea de varios dientes es posible, como demuestra el estudio de Seres utilizando la primera y la segunda molar superior [24].

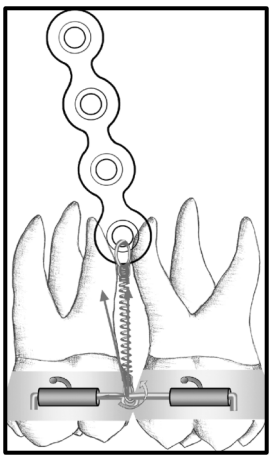


Figura 11: Intrusión para Seres y Kocsis de dos molares superiores simultáneas [24].

El control de algunos movimientos parásitos en relación a la intrusión, se pueden controlar a través de un arco transpalatino o lingual. Todos los pacientes de la muestra de Marzouk 2015 y 2016 han llevado un doble arco transpalatino [28],[29].

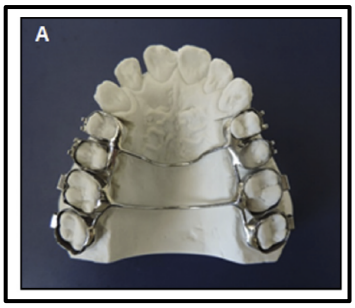


Figura 12: Doble arco-transpalatino [28],[29].

En diferentes estudios, como el de Akan, Seres o incluso Erverdi 2007, efectúan la intrusión antes de la colocación de los Brackets [35],[24],[34]. En el caso de Erverdi y Seres, deciden conservar los molares intruidos mediante una ligadura durante el tratamiento. Por otro lado, Erverdi realiza la intrusión después de cumplir con el tratamiento [34].

En el artículo de Sugawara, se descubre una reducción de la altura de los primeros y segundos molares superiores (U6-PP y U7-PP), debido a que la mini placa se ubica en la mandíbula realizando una intrusión del molar inferior [32].

Mordida abierta

Por otro lado, es interesante saber si una intrusión molar cierra bien una mordida abierta, así como qué cantidad de intrusión molar es necesaria para el cierre de una mordida abierta. En concreto, cuántos milímetros de intrusión son necesarios para obtener un cierre de un milímetro de mordida abierta. Observando la evolución de la mordida abierta después de una intrusión molar superior, se nota una disminución de 5,12 milímetros hasta 6,93 milímetros en el artículo de Marzouk [29].

Para corregir una mordida abierta hasta 3 milímetros, Jorge Faber alaba la utilización de la mini placa en el maxilar o en la mandíbula. Si la mordida abierta aparece por encima de 3 milímetros, debe ser tratada mediante la utilización de las mini placas ingresando los molares superiores e inferiores [5].

Marzouk comenta que es útil tratar una mordida abierta anterior severa hasta 8,5 milímetros mediante una mini placa ubicada en el cigomático [28].

En general, una intrusión molar de 2 a 3 milímetros es suficiente para realizar una corrección de una mordida abierta severa [42].

Resalte

El resalte ha disminuido en todos los artículos estudiados, reportando un -3,39 milímetros en el estudio de Marzouk en 2016 [29] y de -1,1 milímetros en el estudio de Dagadar [3].

El artículo de Jae Hyun Park describe el tratamiento de un paciente que inicialmente obtuvo 7,5 milímetros de resalte y 2,5 milímetros de mordida abierta. En dicho paciente se ha realizado la colocación de dos placas de anclajes ubicadas, respectivamente, en cada maxilar [37].

A nivel incisal

Podemos analizar si una intrusión molar tiene influencia sobre la posición o sobre el ángulo de los incisivos tanto superiores como inferiores.

Erverdi en el año 2004 observa una extrusión de los incisivos mandibulares de 1,1 milímetros, según él sería provocada por el nivelado de la dentición, así como una extrusión de los incisivos maxilares [9].

Como he relatado anteriormente, en el estudio de Sugawara la ubicación de la mini placa se encuentra en la mandíbula, se menciona una extrusión mínima de los incisivos [32].

Sin embargo, otro estudio como el de Akan no relata una extrusión de los incisivos, como en el estudio de Talles Oliveira, donde no se utilizan mecánicos ortodónticos en el sector anterior porque la extrusión de estos dientes anteriores no forma parte del estudio [35],[36].

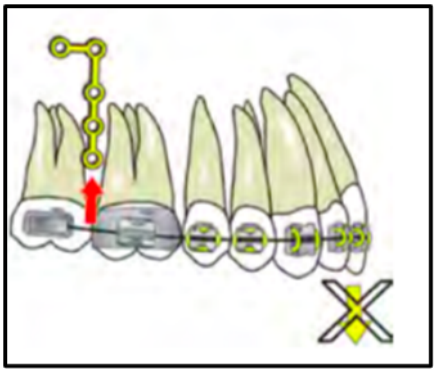


Figura 13: Intrusión molar sin provocar extrusión de los incisivos [5].

Marzouk, revela un aumento del ángulo entre el plano de Franckfort y el eje del incisiva inferior, así como del ángulo interincisivo, que es provocado para la auto rotación de la mandíbula después de una intrusión del sector posterior mediante mini placa [28]. No obstante, un cambio del ángulo interincisivo no siempre es deseado, por esta razón Marzouk sugiere un ajuste del torque [28].

Plano oclusal

Podemos analizar cómo evoluciona el plano oclusal según la cantidad de intrusión de los molares.

En la literatura de algunos estudios, se ha descrito una rotación horaria del plano oclusal [(9),(36),(41)] y en otros se ha descrito una rotación anti horaria [(33),(34)].

Erverdi en 2004, observa una rotación horaria del plano oclusal (plano-oclusal, SN), con una medida positiva de alrededor 3,1°. El autor nota un ligero vestíbulo versión de los molares maxilares con un promedio de 2,8° aún utilizando el arco transpalatino [(9)].

Oliveira nota un giro del plano oclusal de manera horaria de 4,27°, observado encima de una radiografía lateral, sin embargo, sobre una radiografía oblicua no se percibe un cambio significante en esta rotación del plano oclusal. Esta anomalía es provocada por la utilización de los diferentes puntos de referencias para dibujar el plano oclusal. En la radiografía cefalométrica lateral se trazó el plano oclusal desde la cúspide mesial del molar superior con el eje incisal de los incisivos superiores. En la radiografía oblicua el plano oclusal se trazó entre la cúspide del molar y del primer premolar [(36)].

Sin embargo, Erverdi en 2007 publica un estudio en el cual el plano oclusal ha sufrido un cambio entre 2,4°± 1,4° en el sentido anti horario [(34)].

- Cambios cefalométricos a nivel esquelético.

Posición antero posterior del maxilar

Se analiza la posición del maxilar después de una intrusión de los molares superiores, mediante el ángulo SNA. No ha provocado ningún cambio en la mayoría de los autores o un cambio poco notable [3],[32],[34],[35]. Por Marzouk y Erverdi ha ocurrido un cambio de 1° hasta 1,66° [9],[29].

Posición antero posterior de la mandíbula

Se observan repercusiones mandibulares en el sentido anteroposterior. Es interesante examinar la correlación entre la intrusión molar (la diferencia de U6-PP = 2,27) y el ángulo SNB. En todos los artículos analizados, el ángulo SNB ha aumentado en 1,95° de media. Además, se relata en la tabla de Sherwood del cambio cefalométrico un aumento del ángulo SNB y el punto B ha sufrido un desplazamiento hacia arriba y adelante [33].

En algunos de ellos se observa que el ángulo Sn-Pog aumenta de media en 1,96° [28],[44].

Según el modelo de pronóstico de Kasem y Marzouk en 2018, para una intrusión molar de 3 milímetros, el pogonion se adelanta de promedio 2,37 milímetros [45].

Sherwood ha preferido estudiar el ángulo Sn-Gn y ha encontrado un aumento de 2,62° [33].

Rotación mandibular

La intrusión molar, mediante la mini placa, provoca una rotación mandibular anti horaria.

La rotación anti horaria se menciona en todos los artículos después de realizar una intrusión molar mediante mini placa [28],[33],[36].

Analizando las repercusiones mandibulares en el sentido vertical, después de una intrusión molar mediante las mini placas, la magnitud de la auto rotación de la mandíbula depende de diferentes factores como pueden ser la cantidad de intrusión, la fuerza de tracción aplicada, la duración de la intrusión y la ubicación de la mini placa [35],[46].

Utilizando 400 gramos de fuerza en la parte posterior, los autores llegan a una auto rotación de la mandíbula de 2° hasta 4° entre el ángulo del plano GoGn y el plano SN (base del cráneo) [35],[34].

En varios estudios se correlaciona el plano mandibular MP con SN (base del cráneo) dónde se observa que el plano mandibular MP-SN se ha cerrado una media de 2,36° [24],[28],[29],[33].

Alsafadi realiza una revista en la cual nota una rotación anti horaria de la mandíbula de 2,3° hasta 3,9° cuando se aplica la fuerza de intrusión sobre los mini tornillos, actuando tanto en los molares superiores como en los molares inferiores. Este autor considera similar la intrusión realizada mediante la tracción sobre los mini tornillos y la tracción realizada mediante las mini placas actuando en conjunto a un tope oclusal de acrílico [46].

En el artículo de Dadgar y Akan se utiliza el plano mandibular con el plano de Frankfort (MP-FH), dónde se aprecia un cierre del plano mandibular de 3,13° [3],[35].

Para realizar una intrusión de un milímetro se necesitan de media entre 5 y 10 meses, permitiendo una cerrada de mordida abierta de 3 milímetros por rotación anti horaria [42].

A corto plazo, las mini placas colocadas tanto en la mandíbula como en el maxilar ayudan a la intrusión de los dientes molares entre 3 y 5 milímetros logrando una rotación anti horaria de la mandíbula [12].

Seres menciona una auto rotación de la mandíbula detallando un giro del plano mandibular de 3,1° e indica que el punto B ha girado hacia anterior, así como hacia arriba [24].

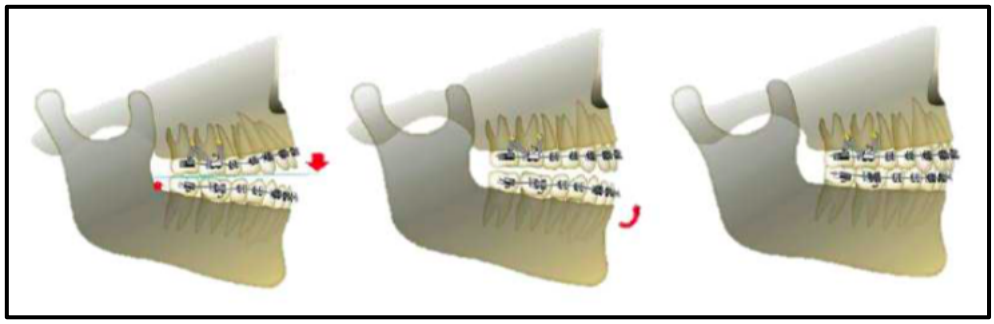


Figura 14: Rotación anti horaria de la mandíbula por intrusión de los molares [10].

Altura facial

La reducción de la altura facial ha sido abordada en varios estudios. También tenemos en cuenta el perfeccionamiento de la estética facial provocado con la disminución de la altura

facial anterior, la distancia N-Me(mm) y la distancia de ANS-Me, mencionadas en varios artículos [24],[28],[29],[32],[33],[35].

El valor medio de ANS-Me ha disminuido de media en -3,11 milímetros [28],[29],[33],[35] y de -2,78 milímetros según Akan [35] e incluso hasta -3,57 milímetros según Marzouk [29]. La distancia entre N-Me(mm) y la altura facial anterior total ha disminuido de media en -3,3 milímetros [24],[33],[35] y -2,63 milímetros por Sherwood hasta -3,95 milímetros por Akan [35].

Según el artículo de Kassem y Marzouk, para una intrusión molar de 3 milímetros, la altura facial disminuiría en -3,18 milímetros [45].

En el artículo de Alsafadi, así como en el de Erverdi 2004, se ha notado una mejoría de la estética facial mediante la disminución de LAFH [9],[46].

Algunos estudios, como el de Erverdi (2004) contiene la extracción de los primeros premolares. En el caso de seis pacientes sobre diez en total se podría preguntar si la altura facial podría haberse alterado [9]. Así que en el estudio de Marzouk 2016, se ha realizado la extracción de los cuatros primeros premolares después de la intrusión, con el objetivo de la corrección del apiñamiento y reducir el ángulo interincisivo [29].

En el artículo de Dadgar se extrae el primer molar izquierdo mandibular y el primer molar derecho maxilar, sin embargo, este caso estaría relacionado a un pobre diagnóstico de estos

dientes. Se trata de un paciente de Clase II con un exceso vertical anterior severo. Dadgar concluye una mejora de la estética facial [3].

Scheffler y Proffit estiman que es importante controlar la posición vertical de los molares mandibulares y al mismo tiempo realizar una intrusión de los molares superiores con el objetivo de obtener una disminución de la altura facial [40].

- **Recidivas de tratamientos realizado con TADs.**

La corrección de la mordida abierta es compleja debido a la alta frecuencia de recidiva.

Sugawara publica un estudio retrospectivo con nueve personas, obteniendo distintos resultados, entre otros, de la recidiva después de un año de la remoción de la placa. Sugawara intruye los primeros molares mandibulares de 1,7 milímetros y los segundos molares mandibulares se intruyen de 2,8 milímetros. La cantidad de recidiva analizada tiene como promedio 0,5 milímetros después de un año, correspondiendo a un 27,2% en los primeros molares mandibulares y un 0,9 milímetros, es decir, un 30,3% en los segundos molares por lo que Sugawara recomienda realizar un sobre tratamiento [32].

En el estudio de Seres con sietes pacientes, se observa después del tratamiento desde una mínima hasta una media tasa de recidiva de la mordida abierta, sin hacer mención la cantidad de la misma encontrada en dicho tratamiento [24].

Marzouk evalúa la estabilidad de la intrusión molar y la corrección de la mordida abierta con una muestra de 26 adultos. Consigue un promedio de intrusión de los molares de 3,04 milímetros, con un cierre de mordida abierta con promedio de 6,93 milímetros. Se analiza que la recidiva de la intrusión molar del maxilar en el primer año es de un 10,20% después del final del tratamiento y de un 13,37% al cuarto año después del final del mismo. Por otro lado, en cuanto a la recidiva de la mordida abierta, es de un 8,19% en el primer año post tratamiento hasta alcanzar un 11,18% en el cuarto año [(29)].

Además, concluyen que la intrusión molar superior realizada con mini placas, ubicadas a nivel del cigomático, se encuentra estable cuatro años después del final del tratamiento [(29)].

Al-Dhubhani elabora en el año 2018 una revista sistemática sobre 95 pacientes. Constata la corrección de la mordida abierta por intrusión de los dientes posteriores mediante TADs, que es una estrategia de tratamiento bastante estable a corto y largo plazo con un estricto protocolo de retención. Cuatro años después de la remoción, la mordida abierta recidiva es de 0,3 hasta 1,2 milímetros y la recidiva de la intrusión molar se encuentra entre los 0,3 y los 0,5 milímetros, la mayoría ha ocurrido durante el primer año [(47)].

El articulo de Baek, intruyó los primeros molares superiores y a los 3 años después del tratamiento constata una recidiva del 22,88%. El 80% del total de la recibida ocurrió durante el primer año de retención. La recidiva de la mordida abierta ha sufrido un 17% al final de los 3 años de tratamiento y la mayor parte de la misma ha ocurrido en el primer año de retención. Así que el autor concluyó que, si se utiliza un método de retención apropiado durante el primer año de tratamiento, la estabilidad después del tratamiento está garantizada [(39)].

Daybelis González realizó un estudio en 2020 sobre la estabilidad de la intrusión molar mediante los anclajes esqueléticos. Se relata una recidiva de la mordida abierta de -1,23 milímetros. Por otra parte, la intrusión molar analizada llega alrededor del 12% en los molares superiores alcanzando un 27,2% para la intrusión de los molares mandibulares. No obstante, los artículos empleados mezclan los diferentes anclajes esqueléticos temporales [(48)].

Scheffler y Proffit relatan que la intrusión de los molares es concluyente en casos severos y moderados, debido a una disminución de la mordida abierta de 5 hasta 6 milímetros, sin embargo, se obtiene una recidiva de 0,5 hasta 1,5 milímetros [(40)].

Lee, en su estudio realizado sobre 11 pacientes, constata que la recidiva de la intrusión molar es de un 10,36%. Ha relatado una disminución de la mordida abierta de 0,99 milímetros después de 17,4 meses de retención y su recidiva es de 18,10%. Concluyó que utilizar los mini tornillos es efectivo en los pacientes adultos para una intrusión del maxilar superior [(38)].

En el Estudio de Marzouk, se detalló la estabilidad de los cambios cefalométricos producidos en los tejidos blandos durante un tratamiento de una mordida abierta tratado mediante mini placas [(45)]. Se concluyó que la mayoría de la recidiva de los tejidos blandos aparecen en el primer año, con un porcentaje entre el 62,5% y el 76% correspondiente al porcentaje de recidiva del primer molar intruido (76,29%) y de la recidiva de la mordida abierta 73,2% [(29),(45)].

Dagdar también observa que la recidiva tiene origen en la adaptación de la musculatura tras la rotación mandibular secundaria a la intrusión [(3)].

Garrett y Baker concluyen que si la lengua está controlada, así como si el tratamiento de la mordida abierta está realizado de manera razonable con método mecánico, promete una estabilidad del tratamiento para el paciente [31].

Se aconseja la utilización de las placas en pacientes que tienen un buen sellado labial si la mordida se corrige mediante la intrusión de los molares [4].

Retención:

La mayoría de los autores coinciden en la necesidad de la utilización de la placa de contención para disminuir la cuantidad de recidiva [31],[39].

Durante la fase de retención se emplea una placa de Hawley durante todo el día y todas las noches durante el primer año, disminuyendo su tiempo de uso a medida que pasa el tiempo, hasta llevarla una noche a la semana durante el cuarto año [29]. La fase de retención fue realizada mediante retenedor Essix durante 20 meses en el articulo de Garrett. Se utilizaba de manera continua durante 6 meses y después únicamente durante la noche [31].

Según Marzouk la cantidad de recidivas de la intrusión molar, así como la recidiva de la mordida abierta están correlacionadas con la altura inicial de la molar maxilar antes de comenzar el tratamiento, así como con la severidad de la mordida abierta inicial. Sin embargo, no encuentra relación con la cantidad de intrusión y la cantidad de corrección llevada a cabo durante el tratamiento [29].

La mayoría de los cambios cefalométricos se mantienen estables hasta un año después de la remoción de la placa. Sin embargo, el plano mandibular (FH-MP) ha incrementado 0,4° y ALFH (altura facial anterior) ha aumentado 0,6 milímetros [32].

Akan concluye que la intrusión de los molares posteriores superiores, utilizando un anclaje cigomático, es un tratamiento exitoso para tratar las mordidas abiertas sin efectos notados sobre los músculos masticatorios [35].

Se afirma en varios estudios que la utilización de las mini placas para realizar una intrusión molar es un método eficaz [28],[32],[33],[34].

6. CONCLUSIONES

El uso de las mini placas es una técnica eficaz y segura que permite la corrección de una mordida abierta por intrusión de los molares. Sin embargo, la comparación exacta de los cambios cefalométricos es complicada de alcanzar debido a que no existe consenso en las referencias a utilizar.

Mediante el uso de las mini placas para el cierre de la mordida abierta se produce una intrusión molar y aumento del ángulo interincisivo, no se produce extrusión de los incisivos superiores.

La intrusión de molares superiores e inferiores han permitido una rotación de la mandíbula en el sentido anti horario, provocando una disminución del plano mandibular (MP-SN°). Además, se produce una rotación del plano oclusal, un avance del pogonion, una disminución de la altura facial total y anterior, y una disminución del resalte.

Durante el primer año tras el tratamiento de la mordida abierta mediante intrusión molar, se produce recidiva de la maloclusion y será necesaria una fase de retención. Hacen falta más estudios para poder cuantificar la recidiva del movimiento de la intrusión molar.

Seria interesante estudiar el enlace entre la recidiva y la tonicidad muscular peri oral, particularmente de los músculos masticatorios y labiales, así como analizar las repercusiones cefalométricas que se producen sobre los tejidos blandos tras una intrusión molar mediante TADs.

7. RESPONSABILIDAD

Gracias al método de intrusión se alcanza un cierre de la mordida abierta, permitiendo una mejoría de la estética facial y de la sonrisa. Este método hace que el paciente se sienta mejor consigo mismo, obteniendo mayor seguridad y confianza frente a la sociedad que le rodea debido a que posee una buena estética dental. Además, la inserción de las mini placas evita una cirugía ortognática la cual conlleva un coste económico alto, así como puede repercutir en la salud del paciente (mayor riesgo como pueden ser infecciones, seccionar los nervios, etc.). Se trata de un método de intrusión más accesible a la población. Por otra parte, cuando hay solo contacto a nivel posterior implica que los dientes pueden debilitarse, lo que podría provocar una posible fractura la cual supone tener que colocar coronas e incluso implantes o puentes si se pierde totalmente el diente, tratamiento que económicamente son costosos.

8. BIBLIOGRAFÍA

1. Canut JAB. Ortodoncia clínica y terapética. 2.ª ed. Masson; 2000. 179-200 p.

2. Salguero ÁEM, Valverde AS. Corrección de una mordida abierta anterior esquelética mediante miniimplantes y un bite block modificado. Rev Mex Ortod. 2017;5(2):107-15.

3. Dadgar S, Sobouti F, Armin M, Esnaashari N. Correction of Skeletal Openbite Using Zygomatic Miniplates. Br J Med Med Res. 2017;19(6):1-10.

4. Sakima MT, Mendonça AA de, Ocanha Júnior JM, Sakima T. Sistema de Apoio Ósseo para Mecânica Ortodôntica (SAO®): miniplacas para ancoragem ortodôntica. Parte I: tratamento da mordida aberta. Rev Dent Press Ortod e Ortop Facial. 2009;14(1):103-16.

5. Faber J, Morum TFA, Leal S, Berto PM, Carvalho CK dos S. Miniplates allow efficient and effective treatment of anterior open bites. Rev Dent Press Ortod e Ortop Facial. 2008;13(5):144-57.

6. SFODF. Dictionnaire des termes d'orthognathodontie. En SFODF; 2007. p. 96.

7. Erverdi AN. Bone anchorage: when and why? J Indian Orthod Soc [Internet]. 2015;49(Special Issue). Disponible en: www.jios.in

8. Umemori M, Sugawara J. Skeletal anchorage system for open-bite correction. Am J Orthod Dentofac Orthop. 1999;115(2):166-74.

9. Erverdi N, Keles A, Nanda R. The use of skeletal anchorage in open bite treatment: A cephalometric evaluation. Angle Orthod. 2004;74(3):381-90.

10. Sherwood K. Correction of Skeletal Open Bite with Implant Anchored Molar/Bicuspid Intrusion. Oral Maxillofac Surg Clin North Am. 2007;19(3):339-50.

11. De Clerck HJ, Cornelis MA, Cevidanes LH, Heymann GC, Tulloch CJF. Orthopedic Traction of the Maxilla With Miniplates: A New Perspective for Treatment of Midface Deficiency. J Oral Maxillofac Surg [Internet]. 2009;67(10):2123-9. Disponible en: http://dx.doi.org/10.1016/j.joms.2009.03.007

12. Duran F, Sciaraffia, Hormazábal; F, Toledo; X, Chang R-H, González N, et al. una descripcion general y actualizada de miniplacas y minitornillos. Efectos dentoalveolares y esqueleticos. Int J Odontostomat. 2020;14(1):136-46.

13. Sugawara J. Temporary skeletal anchorage devices: The case for miniplates. Am J Orthod Dentofac Orthop [Internet]. 2014;145(5):559-65. Disponible en: http://dx.doi.org/10.1016/j.ajodo.2014.03.010

14. Thébault B, Bédhet N, Béhaghel M, Elamrani K. The benefits of using anchorage miniplates. Are they compatible with everyday orthodontic practice? Int Orthod. 2011;9(4):353-87.

15. D G. Plaque d'ancrage ortodontique [Internet]. Disponible en: https://www.globald.com/orthodontie/materiel-orthodontie/gamme-ancotek/plaques-ancrage-orthodontique/

16. Lam R, Goonewardene MS, Allan BP, Sugawara J. Success rates of a skeletal anchorage

system in orthodontics: A retrospective analysis. Angle Orthod. 2018;88(1):27-34.

17. Tripathi T, Singh N, Rai P, Kalra S. Putty Pack for Prevention of Soft-Tissue Overgrowth Around Surgical Miniplates. J Clin Orthod. 2015;49(8):516-7.

18. Cornelis MA, Scheffler NR, Mahy P, Siciliano S, De Clerck HJ, Tulloch JFC. Modified Miniplates for Temporary Skeletal Anchorage in Orthodontics: Placement and Removal Surgeries. J Oral Maxillofac Surg. 2008;66(7):1439-45.

19. Miyawaki S, Koyama I. No Factors associated with the stability of titanium screws placed in the posterior region for ortodontic anchorage. Am J Orthod Dentofac Orthop. 2013;8.

20. Hourfar J, Kanavakis G, Goellner P, Ludwig B. Fully customized placement of orthodontic miniplates: A novel clinical technique. Head Face Med. 2014;10(1):1-7.

21. Takaki T, Tamura N, Yamamoto M, Takano N, Shibahara T, Yasumura T, et al. Clinical study of temporary anchorage devices for orthodontic treatment--stability of micro/mini-screws and mini-plates: experience with 455 cases. Bull Tokyo Dent Coll. 2010;51(3):151-63.

22. Findik Y, T B, E E, MH T. Surgical difficulties, success, and complication rates of orthodontic miniplate anchorage systems: Experience with 382 miniplates. Niger J Clin Pr. 2017;6:512-6.

23. Kook YA, Park JH, Bayome M, Kim S, Han E, Kim CH. Distalization of the mandibular dentition with a ramal plate for skeletal Class III malocclusion correction. Am J Orthod Dentofac Orthop. 2016;150(2):364-77.

24. Seres L, Kocsis A. Closure of severe skeletal anterior open bite with zygomatic anchorage. J Craniofac Surg. 2009;20(2):478-82.

25. Reichert I, Figel P, Winchester L. Orthodontic treatment of anterior open bite: a review article--is surgery always necessary? Oral Maxillofac Surg. 2014;18(3):271-7.

26. Hoste S, Vercruyssen M, Quirynen M, Willems G. Risk factors and indications of orthodontic temporary anchorage devices: a literature review. Aust Orthod J. 2008;24(2):140-8.

27. Chen YJ, Chang HH, Huang CY, Hung HC, Lai EHH, Yao CCJ. A retrospective analysis of the failure rate of three different orthodontic skeletal anchorage systems. Clin Oral Implants Res. 2007;18(6):768-75.

28. Marzouk ES, Abdallah EM ohame., El-Kenany WA. Molar Intrusion in Open-bite Adults Using Zygomatic Miniplates. Int J Orthod Milwaukee. 2015;26(2):47-54.

29. Marzouk Se, E.Kassem H. Evaluation of long-term stability of skeletal anterior open bite correction in adults treated with maxillary posterior segment intrusion using zygomatic miniplates .pdf. Amrican J Orthod Dentofacil Orthop. 2016;150(1):78-88.

30. Kamlesh Singh, Deepak Kumar, 1 Raj Kumar Jaiswal and AB. Temporary anchorage devices – Mini-implants. J Maxillofac Surg [Internet]. 2010; Disponible en: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3304189/

31. Garrett J, Araujo E, Baker C. Open-bite treatment with vertical control and tongue reeducation. Am J Orthod Dentofac Orthop. 2016;149(2):269-76.

32. Sugawara J, Baik UB, Umemori M, Takahashi I, Nagasaka H, Kawamura H, et al. Treatment and posttreatment dentoalveolar changes following intrusion of mandibular molars with application of a skeletal anchorage system (SAS) for open bite correction. Int J Adult Orthodon Orthognath Surg. 2002;17(4):243-53.

33. Sherwood KH, Burch JG, Thompson WJ. Closing anterior open bites by intruding molars with titanium miniplate anchorage. Am J Orthod Dentofac Orthop. 2002;122(6):593-600.

34. Erverdi N, Usumez S, Solak A, Koldas T. Noncompliance open-bite treatment with zygomatic anchorage. Angle Orthod. 2007;77(6):986-90.

35. Akan S, Kocadereli I, Aktas A, Tasar F. Effects of maxillary molar intrusion with zygomatic anchorage on the stomatognathic system in anterior open bite patients. Eur J Orthod. 2013;35(1):93-102.

36. Oliveira TFM, Nakao CY, Gonçalves JR, Santos-Pinto A. Maxillary molar intrusion with zygomatic anchorage in open bite treatment: lateral and oblique cephalometric evaluation. Oral Maxillofac Surg. 2015;19(1):71-7.

37. Park JH yu., Tai K, Takagi M. Open-bite treatment using maxillary and mandibular miniplates. J Clin Orthod. 2015;49(6):398-408.

38. Lee H, Park Y. Treatment and postrearment changes following intrusion of maxillary posterior teeth with miniscrew implants for open bite correction. Korean J Orthod. 2008;31-40.

39. Baek M, Choi Y, Yu H, Lee K, Kwak J, Park YC. Long-term stability of anterior open-bite

treatment by intrusion of maxillary posterior teeth. Am J Orthod Dentofac Orthop [Internet]. 138(4):396-8. Disponible en: http://dx.doi.org/10.1016/j.ajodo.2010.05.006

40. Scheffler NR, Proffit WR, Phillips C. Outcomes and stability in patients with anterior open bite and long anterior face height treated with temporary anchorage devices and a maxillary intrusion splint. Am J Orthod Dentofac Orthop. 2014;146(5):594-602.

41. Akay MC, Aras A, Günbay T, Akyalçin S, Koyuncue BÖ. Enhanced Effect of Combined Treatment With Corticotomy and Skeletal Anchorage in Open Bite Correction. J Oral Maxillofac Surg [Internet]. 2009;67(3):563-9. Disponible en: http://dx.doi.org/10.1016/j.joms.2008.06.091

42. Barros S GD. Open-bite Malocclusion : Treatment and Stability. Wiley-Blac. Guiherme J, Valarelli Fabricio, editores. Saint-Louis; 2014. 476 p.

43. Kuroda S, Sakai Y, Tamamura N, Deguchi T, Takano-Yamamoto T. Treatment of severe anterior open bite with skeletal anchorage in adults: Comparison with orthognathic surgery outcomes. Am J Orthod Dentofac Orthop. 2007;132(5):599-605.

44. Marzouk ES, Kassem HE. Long-term stability of soft tissue changes in anterior open bite adults treated with zygomatic miniplate-anchored maxillary posterior intrusion. Angle Orthod. 2017;88(2):163-70.

45. Kassem HE, Marzouk ES. Prediction of changes due to mandibular autorotation following miniplate-anchored intrusion of maxillary posterior teeth in open bite cases. Prog Orthod. 2018;19(1):1-7.

46. Alsafadi AS, Alabdullah MM, Saltaji H, Abdo A, Youssef M. Effect of molar intrusion with temporary anchorage devices in patients with anterior open bite: A systematic review. Prog Orthod. 2016;17(1).

47. Al-Dhubhani M. Stability of anterior open bite correction treated with posterior teeth intrusion using temporary anchorage devices. A systematic review. Saudi J Oral Sci. 2018;5(2):69.

48. Daybelis González Espinosa, , Paulo Eliezer de Oliveira Moreira, Amanda Silva da Sousa CF-M and DN. Stability of anterior open bite treatment with molar intrusion using skeletal anchorage : a systematic review and meta-analysis [Internet]. Progress in Orthodontics; 2020. p. 14. Disponible en: https://doi.org/10.1186/s40510-020-00328-2

9. ANEXOS

SNA	No cambio notable o poco cambio Dadgar[3],Sugawara [32], Erverdi[34], Akan[35] Cambio hasta 1,66° para Erverdi [9] y Marzouk [29].
SNB	Aumenta [9],[33],[34],[35],[29] B adelantamiento y arriba para Sherwood [33]. Sn-Pog: aumenta [28],[44] Pog se adelanta [29],[45]
Rotación mandibular	Anti-horaria [9],[34],[35],[38],[40],[43],[46] SN-MP: se cierra (2,36°) [24],[28],[29],[33] Go-Gn: auto rotación [34],[35]
Altura facial	Disminuye [24],[28],[29],[32],[33],[35] N-Me: disminuye [24],[28],[29],[32],[33],[35] ANS-Me: disminuye [24],[28],[29],[32],[33],[35] Control de posición molar en el mismo tiempo que intrusión para Scheffler [40] Exodoncia de dientes (PM, M) [3],[9]

Tabla (1): Resumen de los cambios cefalométricos a nivel dental discutidos tras una intrusión molar mediante TADs.

A nivel molar antagonistas	No se nota egresión molar antagonista para Akan [35] Pequeña extrusión del molar antagonista para Kuroda [43]
Mordida abierta	Disminuye, objetivo a alcanzar
Resalte	Disminuye: - 3,39 mm por Marzouk [29] - 1,1mm por Dadgar [3]
A nivel incisal	Extrusión de los incisivos maxilar para Everdi [9] y Sugawara [32] No se nota la extrusión de los incisivos para Akan [35] y Olivera [36] Aumentación del ángulo entre el plano de Franckfort y incisivos inferiores para Marzouk [28]
Plano Oclusal	Rotación de manera horaria por Everdi[9], Olivera [36] y Akay [41] Rotación de manera anti horaria por Sherwood [33] y Erverdi [34]

Tabla (2): Resumen de los cambios cefalométricos a nivel esquelético discutidos tras una intrusión molar mediante TADs.

	Recidiva post tratamiento de:	
	Mordida Abierta	**Cantidad de intrusión molar**
Sugawara [33]	1 año post tratamiento: - **27,2%** en el 1 molar mandibular correspondiendo a (0,5mm) - **30,3%** en el 2 molar mandibular correspondiendo a un (0,9mm)	
Marzouk [29]	1 año post tratamiento: **8,19%** 4 años post tratamiento: **11,18%**	
Al-Bhubhani [47]	4 años post tratamiento: **0,3mm hasta 1,2mm**	**0,3mm hasta 0,5mm** mayoritariamente el 1 año
Baek et al.[39]	3 años post tratamiento: **17%**	3 años post tratamiento: **22,88%** y **80%** el primer año
Daybelis González et al. [48]	Recidiva de **1,23 mm**	**12%** para el molar superior **27,2%** para el molar inferior
Scheffler y proffit [40]	Disminución de la mordida abierta hasta 5-6mm y recidiva de **O,5 hasta 1,5mm**	
Lee [38]	Recidiva de **18,10%**	Recidiva de **10,36%**

Tabla (3): Resumen de la cantidad de recidiva tras una intrusión molar mediante TADs.

Ortodoncia clínica y terapéutica

2.ª edición

José Antonio Canut Brusola

ELSEVIER
MASSON

Revista Mexicana de Ortodoncia

Vol. 5, Núm. 2 • Abril-Junio 2017
pp 107-115

CASO CLÍNICO

Corrección de una mordida abierta anterior esquelética mediante miniimplantes y un *bite block* modificado

Correction of an skeletal anterior open bite with mini-screws and a modified bite block

Ángel Eduardo Miranda Salguero,* Alfredo Sánchez Valverde§

RESUMEN

La mordida abierta esquelética anterior puede ser tratada con miniimplantes, ya que proveen un anclaje absoluto para corregir mediante la intrusión de los molares maxilares con un adecuado control, el presente caso se ayudó con un *bite block* modificado. Se presenta el caso de un paciente de 15 años de edad, dolicofacial, con una maloclusión clase II subdivisión 1, mordida abierta anterior de -4.5 mm e incompetencia labial. Etiología: por una altura facial anterior superior disminuida. El objetivo del tratamiento fue conseguir una adecuada sobremordida anterior disminuyendo la altura maxilar dentoalveolar posterior. La cirugía ortognática se le indicó pero fue rechazada. Por lo tanto se realizó una intrusión molar superior con dos miniimplantes colocados en el paladar más un *Bite block* modificado activado con cadenas elásticas. **Resultados:** La intrusión molar superior fue de -2 mm, la sobremordida anterior cambió a +2 mm, hubo autorotación mandibular y se mejoró el perfil facial. **Conclusiones:** La mordida abierta anterior fue corregida con un adecuado control de la intrusión evitando alguna inclinación bucal de los molares.

ABSTRACT

Skeletal anterior open bite may be treated with mini-screws since they provide an absolute anchorage to correct it through maxillary molar intrusion. With an adequate control a bite block was used in this case to help correct the malocclusion. **Case report:** A 15 year-old male dolichofacial patient with an Angle class II division 1 malocclusion, a -4.5 mm anterior open bite and incompetent lips is hereby presented. Etiology: reduced anterior upper facial height. The treatment goal was to obtain a normal anterior overbite decreasing the posterior maxillary dentoalveolar height. Orthognathic surgery was indicated but the patient refused it. So the treatment consisted in two mini-screws implanted on the palatal side and a modified fixed bite block, activated with elastomeric chains. **Results:** A molar intrusion of 2 mm was achieved; the anterior overbite changed to +2 mm, a mandibular counterclockwise rotation took place and the facial profile was improved. **Conclusions:** The anterior open bite was corrected with a good control during molar intrusion and without buccal tipping.

Palabras clave: Mordida abierta, miniimplantes, intrusión molar, *bite block*.
Key words: Open bite, mini-screws, molar intrusion, bite-block.

ANTECEDENTES

La mordida abierta es una maloclusión del plano vertical, debido a la falta de contacto anterior puede ser el problema dental o esqueletal.[1] Se atribuye a una etiología de tipo multifactorial como pueden ser genéticos, anatómicos y el ambiente como el desarrollo de hábitos perniciosos bucales.[2,3] La prevalencia de la mordida abierta anterior se considera que corresponde al 3.5% de las maloclusiones (ocho a 17 años de edad).[4] En la población mexicana a edades tempranas la mordida abierta se relaciona en 96.6% a hábitos.[5]

El paciente de mordida abierta se caracteriza por su facie adenoidea o síndrome de cara larga. Con una incompetencia labial por la proclinación de los incisivos y falta de sobremordida anterior, en relación a los hábitos provocan una inflamación gingival.[6] La posición retruída de la mandíbula disminuye la distancia mentocervical y acorta la proyección del mentón.[2] Esta posición mandibular también puede disminuir las vías aéreas a nivel faríngeo.

* Residente de la Especialidad de Ortodoncia.
§ Profesor de Ortodoncia.

División de Estudios de Posgrado e Investigación (DEPeI), Facultad de Odontología (FO), Universidad Nacional Autónoma de México (UNAM).

British Journal of Medicine & Medical Research
19(6): 1-10, 2017; Article no.BJMMR.30193
ISSN: 2231-0614, NLM ID: 101570965

SCIENCEDOMAIN *international*
www.sciencedomain.org

Correction of Skeletal Openbite Using Zygomatic Miniplates

Sepideh Dadgar[1], Farhad Sobouti[1*], Mehran Armin[1] and Nasim Esnaashari[2]

[1]Department of Orthodontics, Dental Faculty, Mazandaran University of Medical Sciences, Sari, Iran.
[2]Department of Orthodontics, Dental Faculty, Islamic Azad University of Isfahan, Isfahan, Iran.

Authors' contributions

This work was carried out in collaboration between all authors. Author SD designed the study and managed the whole treatment. Author FS wrote the protocol and managed the literature searches. Authors MA and NE wrote the first draft of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2017/30193
Editor(s):
(1) Karl Kingsley, Biomedical Sciences and Director of Student Research University of Nevada, Las Vegas - School of Dental Medicine, USA.
Reviewers:
(1) Himawan Halim, Trisakti University, Jakarta, Indonesia.
(2) Karpal Singh Sohal, Muhimbili University of Health and Allied Sciences, Tanzania.
(3) Marcel Marchiori Farret, Centro de Estudos Odontológicos Meridional (CEOM), Brazil.
Complete Peer review History: http://www.sciencedomain.org/review-history/17577

Case Report

Received 23rd October 2016
Accepted 28th December 2016
Published 21st January 2017

ABSTRACT

Aims: Anterior open bite is often caused by excessive vertical development of the posterior maxilla. In such cases, it is hardly possible to establish absolute anchorage for molar intrusion by traditional orthodontic mechanics. The use of skeletal anchorage for orthodontic tooth movement is offering a minimally invasive treatment option for correction of skeletal anterior open bite and enhancement of facial esthetics as an alternative to major surgery.
Presentation of Case: This article reports a case of 23 year old female patient, who had a moderately severe skeletal anterior open bite, that was successfully corrected by using titanium miniplates and miniscrews. The miniplate were inserted in zygomaticomaxillary buttress area and fixed with two miniscrews on each side. Titanium miniscrews were inserted bilaterally in palatal region to preserve molar axial inclination during intrusion. An intrusion force was provided with niti coilsprings for 9 months.
Discussion: After active treatment of 24 months, The mean amount of accomplished molar intrusion was 2.8 mm ± 0.64 mm, with a rate of 0.311 mm ± 0.071 mm per month and a bite closure of 5.61 mm ± 1.23 mm. No significant buccal tip was observed in the right and left molars

**Corresponding author: E-mail: farhad_sobouti@yahoo.com;*
Co-author: E-mail: dadgar_sepideh@yahoo.com;

Sistema de Apoio Ósseo para Mecânica Ortodôntica (SAO®) – miniplacas para ancoragem ortodôntica. Parte I: tratamento da mordida aberta

Maurício Tatsuei Sakima*, Armando Amorim de Mendonça**, José Miguel Ocanha Júnior***, Tatsuko Sakima****

Resumo

Este trabalho descreve uma nova forma de ancoragem por meio de miniplacas denominada SAO®, Sistema de Apoio Ósseo para Mecânica Ortodôntica. Após a descrição do sistema, protocolos de tratamento para mordidas abertas esqueléticas são apresentados. A aplicação de cantiléveres e alças apoiadas diretamente nos tubos do sistema de ancoragem permite que associações de problemas verticais e sagitais (Classe II e III) sejam tratadas de formas distintas. A aplicação de forças leves e constantes e o controle tridimensional das forças aplicadas são o grande diferencial desse novo sistema.

Palavras-chave: Miniplacas. Ancoragem esquelética. Mordida aberta anterior.

INTRODUÇÃO

De acordo com a terceira lei de Newton: "Para toda ação tem-se uma reação de mesma intensidade e sentido oposto". Durante o tratamento ortodôntico, as extensas movimentações de dentes, especialmente caninos e molares, representam um grande desafio no que se refere ao controle de efeitos colaterais no bloco de ancoragem[4]. A introdução do conceito de ancoragem esquelética viabilizou a execução de tratamentos considerados difíceis, complexos ou até impossíveis[2,5]. Dentre os dispositivos para ancoragem esquelética podem-se destacar três principais: implantes ósseo-integrados, mini-implantes e miniplacas.

Os implantes ósseo-integrados, quando utilizados para substituir elementos dentários, podem ser uma boa forma de se conseguir a ancoragem necessária para a movimentação ortodôntica. Espera-se a união bioquímica entre osso e implante, além da retenção mecânica, como meio de obter a ancoragem esquelética[5,6,11,19]. Huang, Shotwell e Wang[8] constataram – em artigo de revisão de literatura – que, em estudos realizados em animais, forças de até 500 gramas podem ser suportadas por esse tipo de implante. A colocação de implantes ósseo-integrados antes do início do tratamento ortodôntico, em casos que necessitarão de reabilitação protética posterior, pode ser uma opção. No entanto, além do tempo de espera para que ocorra ósseo-integração (4 a 6 meses em média), é necessário um estudo minucioso

* Professor assistente doutor do departamento de Clínica Infantil da Faculdade de Odontologia de Araraquara – UNESP. Coordenador do curso de especialização em Ortodontia da Universidade de Franca – UNIFRAN.
** Professor do NETS (Núcleo de Ensino Prof. Tatsuko Sakima). Mestrando do curso de pós-graduação em Ortodontia da Faculdade de Odontologia e Centro de Pesquisas Odontológicas São Leopoldo Mandic. Especialista em Ortodontia pela EAP da APCD – regional Araraquara.
*** Especialista em Ortodontia pela Universidade de Franca – UNIFRAN.
**** Professor titular da Faculdade de Odontologia São Leopoldo Mandic. Coordenador do curso de pós-graduação em Ortodontia da Faculdade de Odontologia e Centro de Pesquisas Odontológicas São Leopoldo Mandic.

Miniplacas permitem tratamento eficiente e eficaz da mordida aberta anterior

Jorge Faber*, Taciana Ferreira Araújo Morum**, Soraya Leal***, Patrícia Medeiros Berto****, Carla Karina dos Santos Carvalho*****

Resumo

Introdução: o tratamento das deformidades e más oclusões que incluem mordidas abertas anteriores foi uma das primeiras aplicações de miniplacas como forma de ancoragem ortodôntica. A implementação desse sistema de tratamento reduz o número de pacientes indicados para a cirurgia ortognática e simplifica muitos problemas. Nessa abordagem, os dentes posteriores são intruídos e a mandíbula sofre um giro no sentido anti-horário, diminuindo a altura facial inferior e projetando os pogônios de tecidos duro e mole. **Objetivo:** o presente artigo apresenta os fundamentos da mecânica ortodôntica para correção da mordida aberta anterior e os ilustra com uma série de casos clínicos.

Palavras-chave: Mordida aberta. Procedimentos de ancoragem ortodôntica. Miniplacas. Ortodontia.

INTRODUÇÃO

Uma terapia ortodôntica bem sucedida depende do planejamento criterioso da ancoragem. O recurso de ancoragem esquelética representou um grande avanço que se consolidou na Ortodontia[10]. Ele é caracterizado pela obtenção de um ponto fixo e imóvel de ancoragem dentro da cavidade bucal, o que facilita a movimentação ortodôntica, pois evita o deslocamento da unidade de resistência. Os implantes ortodônticos temporários são técnicas de ancoragem esquelética que apresentam vantagens em relação à Ortodontia tradicional em muitas situações clínicas, pois não dependem da colaboração do paciente e permitem a aplicação de força em diversas direções, sem a presença de movimentos recíprocos indesejáveis[15].

O advento da ancoragem esquelética tem permitido que profissionais tracem novos caminhos para o tratamento ortodôntico. Tratamentos complexos tornaram-se mais simples e previsíveis, a duração dos tratamentos diminuiu e cirurgias ortognáticas puderam ser evitadas em pacientes que não desejavam se submeter a elas.

Esses resultados foram atingidos com vários sistemas de ancoragem esquelética diferentes. O processo natural de seleção das técnicas restringiu os sistemas de ancoragem a, praticamente, dois grupos: mini-implantes e miniplacas[24]. O uso de miniplacas como ancoragem ortodôntica foi concebido, inicialmente, para distalização de molares inferiores[21]. Entretanto, ganhou popularidade apenas a partir da demonstração de sua aplicabilidade

* Editor-chefe da Revista Dental Press de Ortodontia e Ortopedia Facial. Doutor em Biologia pelo Laboratório de Microscopia Eletrônica da UnB. Mestre em Ortodontia pela UFRJ.
** Especialista em Ortodontia pela FOPLAC. Mestranda em Ciências da Saúde pela Universidade de Brasília.
*** Especialista em Odontopediatria pela ABO-DF. Mestre e Doutora em Ciências da Saúde pela UnB. Professora Adjunto da Universidade de Brasília.
**** Pós-graduanda em Ortodontia - UFG.
***** Mestre em Ciências da Saúde - UnB. Pós-graduanda em Ortodontia - UFG.

sfodf
Société Française
d'Orthopédie Dento-Faciale

DICTIONNAIRE D'ORTHOGNATHODONTIE

- ORTHODONTIE
- ORTHOPÉDIE DENTO-FACIALE

Société Française d'Orthopédie Dento-Faciale

3e édition,
revue et complétée

Bone anchorage: When and why?

Ahmet Nejat Erverdi[1,2]

About the Author

Dr. Nejat Erverdi graduated in 1981 from Hacettepe University Faculty of Dentistry in Ankara . He started his postgraduate education at the Department of Orthodontics of the same faculty and completed his PhD program in 1985. For the military service, Dr. Erverdi attended the Military Postgraduate Education Center in Istanbul and completed his military service as an educator. In 1987 he joined the Marmara University Faculty of Dentistry Department of Orthodontics as a lecturer. In 1988 he became Assistant Professor; in 1989 he passed the exam and became Associate Professor. In 1994 he became a full Professor. Dr. Erverdi is the head of the Department of Orthodontics between 1988-2006. He is one of the founders of the Turkish Orthodontic Society. Since 2000 he is serving as a Council member of the European Orthodontic Society. In 2003 he was accepted as the full member to the North Atlantic Component of the Edward Angle Society. He is the author of over 100 articles in local and international journals and seven international book chapters. He was the president of the IXth International Symposium on Dentofacial Development and Function in October 2002.He was elected as the president of the European Orthodontic Society for the year of 2011. He was the president of EOS congress which was held in June 2011 in İstanbul. His book about Archwise Distraction Osteogenesis was published by Springer company in the year of 2014. He is still investigating and writing about Archwise Distraction Osteogenesis and cleft palate treatment.

Abstract

Anchorage is the most important concept in biomechanics of orthodontics. In contemporary orthodontics, bone anchorage is a magic tool, which decreased the indication for extraoral appliances greatly and at the same time achieving stationary anchorage became possible. However, the indication for bone anchorage has to be clarified carefully. Skeletal open-bite treatment, effective molar distalization, Class III treatment by using chin anchorage, and space closure in severe minimal anchorage cases are some examples for bone anchorage supported orthodontic treatment. Here, we discussed three necessary usages of bone anchorage for different treatment modalities.

Key words: Bone anchorage, orthodontic mini-plates, zygomatic anchorage

Access this article online	
Website: www.jios.in	Quick Response Code
DOI: 10.4103/0301-5742.171197	

[1,2]Professor and Doctor
[1]Departments of Orthodontics, Dental School, Marmara University,
[2]Department of Orthodontics, Marmara University Health Campus,
Başıbüyük, Maltepe, Istanbul, Turkey

Address for correspondence: Dr. Ahmet Nejat Erverdi,
Department of Orthodontics, Marmara University Health Campus,
Dental School, 34854 Başıbüyük, Maltepe, Istanbul, Turkey.
E-mail: erverdi@tnn.net

Received: 10-11-2015, **Accepted with Revisions:** 13-11-2015

Introduction

Anchorage is the most important concept in biomechanics of orthodontics. The well-known quotation from Greek Philosopher, Archimedes "give me a place to stand and I will move the Earth" explains the importance of anchorage perfectly. Anchorage protocol has to be realistic and at the same time enough to

How to cite this article: Erverdi AN. Bone anchorage: When and why?. J Indian Orthod Soc 2015;49:27-32.

CONTINUING EDUCATION ARTICLE

Skeletal anchorage system for open-bite correction

Mikako Umemori, DDS, DDSc,[a] Junji Sugawara, DDS, DDSc,[b] Hideo Mitani, DDS, MS, DDSc,[c] Hiroshi Nagasaka, DDS, DDSc,[d] and Hiroshi Kawamura, DDS, DDSc[e]
Sendai, Japan

A skeletal anchorage system was developed for tooth movements. It consists of a titanium miniplate that is temporarily implanted in the maxilla or the mandible as an immobile anchorage. In this article, we introduce the skeletal anchorage system to intrude the lower molars in open-bite malocclusion and evaluate the results of treatment in two severe open-bite cases that underwent orthodontic treatment with the system. Titanium miniplates were fixed at the buccal cortical bone around the apical regions of the lower first and second molars on both the right and left sides. Elastic threads were used as a source of orthodontic force to reduce excessive molar height. The lower molars were intruded about 3 to 5 mm, and open-bite was significantly improved with little if any extrusion of the lower incisors. No serious side-effects were observed during the orthodontic treatment. The system was also very effective for controlling the cant and level of the occlusal plane during orthodontic open-bite correction. (Am J Orthod Dentofacial Orthop 1999;115:166-74)

It is very important for vertical correction of skeletal open-bite to control the height of the posterior dentoalveolar regions. However, traditional biomechanical techniques, such as the use of a multibracket appliance, an extraoral anchorage, an active vertical corrector with magnets, a vertical-pull chincap, etc, cannot effectively control intrusion of the molars, especially in adult patients. This is because it is extremely difficult to establish a rigid anchorage for molar intrusion in such cases. To obtain a rigid anchorage, dental implants and bone screws have been reported as orthodontic and orthopedic anchors.[1-20] Some new types of implants have been designed to provide anchorage for orthodontic tooth movements.[21,22] For example, Jenner and Fitzpatrick[23] reported a clinical case in which surgical bone plates were used to provide skeletal anchorage.

Recently, as a result of advances in biocompatible medical materials, osteointegrated titanium implants have been developed and used in bone screws and miniplates for rigid fixation in orthognathic surgery. This application leads to the hypothesis that a titanium miniplate[24,25] might also be used as a source of stationary anchorage for tooth movements. Therefore we developed a skeletal anchorage system (SAS) in our clinic using a titanium miniplate that is temporarily implanted in the maxilla and/or mandible as an immobile intraoral anchorage, particularly for intrusion of the molars.

The purpose of this study was to use the SAS for open-bite correction. This article presents the results of

This study was supported by a Grant-in-Aid for Scientific Research from the Ministry of Science, Education and Culture of Japan (#08877306).
From the School of Dentistry, Tohoku University, Japan.
[a]Instructor, Department of Orthodontics.
[b]Associate Professor, Department of Orthodontics.
[c]Professor and Chairman, Department of Orthodontics.
[d]Instructor, First Department of Oral and Maxillofacial Surgery.
[e]Associate Professor, First Department of Oral and Maxillofacial Surgery.
Reprint requests to: Dr. Mikako Umemori, Department of Orthodontics, School of Dentistry, Tohoku University, 4-1 Seiryo-machi, Aoba-ku, Sendai 980-8575, Japan; e-mail: umemori@orthod.dent.tohoku.ac.jp

0889-5406/99/$8.00 + 0 **8/1/90918**

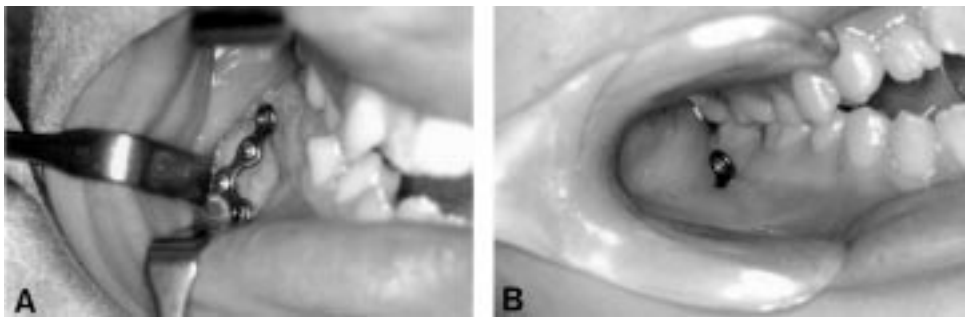


Fig 1. Implantation of a titanium miniplate. **A**, Surgical procedure, **B**, after healing of the wound.

Original Article

The Use of Skeletal Anchorage in Open Bite Treatment: A Cephalometric Evaluation

Nejat Erverdi, DDS, PhD[a]; Ahmet Keles, DDS, DMSc[b]; Ravindra Nanda, BDS, MDS, PhD[c]

Abstract: The aims of the present study were to assess the effectiveness of skeletal anchorage for intrusion of maxillary posterior teeth, to correct open bite malocclusion, and to evaluate the usage of titanium miniplates for orthodontic anchorage. Anterior open bite is one of the most difficult malocclusions to treat orthodontically. Currently, surgical impaction of the maxillary posterior segment is considered to be the most effective treatment option in adult patients. Various studies have reported the use of implants as anchorage units at different sites of midfacial bones for orthodontic tooth movement. The zygomatic buttress area could be a valuable anchorage site to achieve intrusion of maxillary posterior teeth. Ten patients, 17 to 23 years old and characterized with an anterior open bite and excessive maxillary posterior growth, were included in this preliminary study. Titanium miniplates were fixed bilaterally to the zygomatic buttress area, and a force was applied bilaterally with nine mm Ni-Ti coil springs between the vertical extension of the miniplate and the first molar buccal tube. The results showed that, with the help of skeletal anchorage, maxillary posterior teeth were intruded effectively. As compared with an osteotomy, this minimally invasive surgical procedure eased treatment and reduced treatment time and did not require headgear wear or anterior box elastics for anterior open bite correction. In conclusion, the zygomatic area was found to be a useful anchorage site for intrusion of the molars in a short period of time. (*Angle Orthod* 2004; 74:381–390.)

Key Words: Anchorage; Sketal anchorage; Open bite; Dental implant; Miniplate

INTRODUCTION

Anterior open bite is one of the most difficult malocclusions to treat and maintain in orthodontics. The morphologic pattern in anterior open bite is characterized by longer vertical dimensions, an increase in development of the maxillary posterior dentoalveolar structure and a steep mandibular plane.[1–3] The surgical correction of skeletal open bite often requires maxillary impaction to achieve counterclockwise rotation of the mandible and subsequent reduction of anterior facial height.[4] The complexity, the risks, and the cost factor of surgical treatment have initiated a search for alternative clinical procedures.

Bite-blocks with repelling magnets[5–7] or spring-loaded bite-blocks[8] have been applied to achieve dentoalveolar intrusion of the maxillary posterior segments. Fixed mechanics and vertical elastics have also been used to treat anterior open bite.[9–12] Face mask designs have been developed for posterior dentoalveolar intrusion.[13] These procedures have been effective in passive intrusion of the maxillary posterior segment[5–7,13,14] or in anterior dentoalveolar extrusion.[9–12] In all these treatment modalities, however, the correction was achieved primarily through extrusion of incisors or by preventing passive eruption of posterior teeth.

Recent studies have used osseointegrated implants and screws as anchorage units for orthodontic purposes.[15–21] In patients not in need of implants for prosthetic reasons, investigators have used the retromolar area,[22] palatal region,[23–30] or alveolar areas[31] to attach various screws and plates solely for the purpose of orthodontic movement of teeth or segments.

Ohmae et al,[32] using an animal model, and Umemori et al[33] in humans, applied titanium mini plates to the mandibular corpus area and used them as anchorage for intrusion of the mandibular posterior dentoalveolar segment for correction of anterior open bite. Sugawara et al[34] used a specially designed skeletal anchorage system (SAS) for correction of anterior open bite by intruding the mandibular molars in humans. Melsen et al,[35] De Clerck et al,[36] Erverdi

[a] Professor and Chair, Department of Orthodontics, School of Dentistry, Marmara University, Nisantasi, Istanbul, Turkey.

[b] Director of Orthodontic Clinic, Department of Orthodontics, University of Connecticut Health Center, Farmington, Conn.

[c] Professor and Chairman, Department of Orthodontics, University of Connecticut Health Center, Farmington, Conn.

Corresponding author: Ahmet Keles, Director of Orthodontic Clinic, Department of Orthodontics, University of Connecticut Health Center, 263 Farmington Ave, Farmington, CT 06030 (e-mail: keles@ortodonti.com).

Accepted: July 2003. Submitted: June 2003.

ELSEVIER
SAUNDERS

Oral Maxillofacial Surg Clin N Am 19 (2007) 339–350

ORAL AND
MAXILLOFACIAL
SURGERY CLINICS
of North America

Correction of Skeletal Open Bite with Implant Anchored Molar/Bicuspid Intrusion

Keith Sherwood, DDS[a,b]

[a]*Boston University Goldman School of Dental Medicine, 100 East Newton Street, Boston, MA 02118, USA*
[b]*Private Practice, Oral and Maxillofacial Surgery and Orthodontics, 80 Lindall Avenue, Hunt Medical Building, Danvers, MA 01923, USA*

Skeletal open bite is one of the most challenging malocclusions for the orthodontist to accurately diagnose and predictably treat. Orthodontic correction alone, even when initiated at an early age, often leads to long-term relapse. As a result, in an effort to improve stability, combined orthodontics and orthognathic surgery are frequently seen as the treatment of choice or necessity. Recent technical advancements and clinical research in implant-assisted orthodontics has spurred interest in using miniplates and other surgical implant fixtures as anchors to allow minimally invasive correction of skeletal open bite. This article discusses the cause and diagnosis of open bite, historical perspectives on treatment, indications for surgery, use of implant anchors to facilitate correction, and surgeon–orthodontist cooperation.

Literature review

Etiology of open bite

Open bite malocclusion is commonly seen in orthodontic practice. As a result, much of what we know about this bite abnormality comes from the orthodontic literature. It has been shown that orthodontic treatment of open bite is prone to relapse [1]. Most orthodontists consider open bite, especially in adults, to be a significant treatment challenge. In contrast, oral and maxillofacial surgeons see only a fraction of their orthodontic colleagues' open bite patients, usually on referral for orthognathic surgery. The scope, risk, and cost of an osteotomy may drive some patients and orthodontists away from this option. Open bite patients are often sent for surgical correction only after orthodontic treatment has been unsuccessful. This results in a skewed perspective on the part of the surgeon regarding the incidence, etiology, and treatment of open bite and may affect postsurgical stability.

For practical reasons, the orthodontist often takes the lead in the important pretreatment analysis of the origin of an open bite malocclusion. This diagnostic process is often complex, because growth and development, genetic, and habit factors must be considered. When these issues are not taken into account, unnecessary or inappropriate treatment may be instituted and the risk of orthodontic and surgical relapse increases. As with other types of dentofacial deformities, the participating oral and maxillofacial surgeon should understand the nature and etiology of open bite to communicate with the orthodontist, plan appropriate and progressive surgical treatment, and avoid complications.

The nature of the open bite malocclusion can be divided into dental or skeletal, and etiology can be divided into mechanical or genetic factors. Nothing is more critical in treatment planning for the patient who has open bite than determining whether the bite deformity is of dental or skeletal origin. Dental open bite can be treated with orthodontics alone. Skeletal open bite, especially in the adult dentition, usually requires some type of surgical intervention.

E-mail address: ksomsortho@yahoo.com

1042-3699/07/$ - see front matter
doi:10.1016/j.coms.2007.04.001

J Oral Maxillofac Surg
67:2123-2129, 2009

Orthopedic Traction of the Maxilla With Miniplates: A New Perspective for Treatment of Midface Deficiency

Hugo J. De Clerck, DDS, PhD, Marie A. Cornelis, DDS, PhD,†*
Lucia H. Cevidanes, DDS, MS, PhD,‡
Gavin C. Heymann, DDS, MS, PhD,§ and
Camilla J.F. Tulloch, DDS, MS, PhD‖

Class III malocclusion is a consequence of maxillary deficiency and/or mandibular prognathism, often resulting in an anterior crossbite and a concave profile.[1] Young patients with maxillary hypoplasia are usually treated with a facemask: heavy anterior traction is applied on the maxilla to stimulate its growth and to restrain or redirect mandibular growth. Forward and downward movement of the maxilla as well as favorable changes in the amount and direction of mandibular growth has been reported.[2-5] However, these forces generally result in a posterior rotation of the mandible and an increased vertical dimension of the face.[2,4,6] Moreover, dental compensations (proclination of the upper incisors and uprighting of the lower incisors) are observed as a consequence of the application of forces on the teeth,[4,7] and facemask wear is usually limited to 14 hours per day at best.

Titanium miniplates used for anchorage now offer the possibility to apply pure bone-borne orthopedic forces between the maxilla and the mandible for 24 hours per day, avoiding any dentoalveolar compensations.

Summary of Cases and Diagnosis

Three girls (aged 10 to 11 years) presenting with a severe skeletal Class III relationship with a maxillary deficiency and concave soft tissue profile were treated according to the same treatment plan (Figs 1A, 2A, 3A). Two of them had an anterior crossbite without anterior shift of the mandible (cases 2 and 3). One had an edge-to-edge incisor occlusion in centric relation, with a forward posture into maximum intercuspation (case 1).

Pretreatment cephalometric evaluation of the 3 cases showed a skeletal Class III relationship with hypoplasia of the maxilla combined with a normal or increased mandibular size and normal or slightly decreased vertical dimensions (Table 1). The patients' upper incisors were proclined or retroclined, and the lower incisors were normal or proclined.

Treatment Objectives

The main treatment objective was to achieve a reduction of the facial concavity, maximize skeletal maxillary changes, and minimize dentoalveolar movement.

Treatment Plan

The 3 patients were treated exclusively by intermaxillary traction between miniplates placed in the maxilla and in the mandible, in combination with a bite plane to jump the crossbite (Fig 3D).

Treatment Alternatives

The skeletal deformity of these patients was judged too severe to consider treatment by dentoalveolar compensation alone, and the degree of maxillary hypoplasia and age of the patients were not favorable for facemask therapy. Orthognathic surgery after growth completion was offered to the patients. However, to avoid retaining such severe facial deformity until adulthood, each of the 3 patients and their parents preferred to try orthopedic traction from skeletal anchorage, even though they had been informed

*Adjunct Professor, Department of Orthodontics, University of North Carolina, Chapel Hill, Chapel Hill, NC.
†Private Practice, Namur, Belgium.
‡Clinical Assistant Professor, Department of Orthodontics, University of North Carolina, Chapel Hill, Chapel Hill, NC.
§Private Practice, Chapel Hill, NC.
‖Distinguished Professor, Department of Orthodontics, University of North Carolina, Chapel Hill, Chapel Hill, NC.
Address correspondence and reprint requests to Dr De Clerck: Kerkstraat 120, 1150 Brussels, Belgium; e-mail: hugo.declerck@skynet.be

0278-2391/09/6710-0011$36.00/0
doi:10.1016/j.joms.2009.03.007

Int. J. Odontostomat.,
14(1):136-146, 2020.

Una Descripción General y Actualizada de Miniplacas y Minitornillos. Efectos Dentoalveolares y Esqueléticos

A General and Updated Description of Miniplates and Miniscrews. Dentoalveolar and Skeletal Effects

Francisca Durán[1]; Francisca Hormazábal[2]; Ximena Toledo[2]; Ru-Harn Chang[2]; Natalia González[2] & Paulina Sciaraffia[2]

DURÁN, F.; HORMAZÁBAL, F.; TOLEDO, X.; CHANG, R. H.; GONZÁLEZ, N. & SCIARAFFIA, P. Una descripción general y actualizada de miniplacas y minitornillos. efectos dentoalveolares y esqueléticos. *Int. J. Odontostomat., 14(1)*:136-146, 2020.

RESUMEN: En ortodoncia, las miniplacas se utilizan como dispositivo de anclaje temporal (TAD) para la realización de movimientos dentales que permiten el uso de fuerzas ortopédicas en ellos. En comparación con los mini tornillos, las miniplacas tienen la ventaja de una tasa de falla muy baja, pero la desventaja es que para la extracción se necesita el mismo acto quirúrgico que se realizó para la instalación. El objetivo de este estudio es realizar una revisión bibliográfica de las indicaciones de miniplacas en pacientes con mordidas abiertas, clase II y anomalías de clase III, y buscar cómo las miniplacas han mejorado los tratamientos de ortodoncia. La información principal se reunió buscando en PubMed con las palabras clave enumeradas a continuación. Afirmamos que las miniplacas están indicadas para la retracción en masa de la arcada, donde se observó que la fuerza de 150 g aplicada en los molares superiores es suficiente no solo para empujar los molares hacia atrás en una clase I corregida, sino también para iniciar la retracción de premolares, caninos e incisivos. En pacientes con mordida abierta, las miniplacas se definen como un método seguro, una alternativa rápida y menos costosa a la cirugía ortognática. Y en pacientes de las clases II y III se utilizan sin producir efectos dentoalveolares que sustituyan a los dispositivos extraorales como máscaras, con dispositivos intraorales y elásticos (BAMP).

PALABRAS CLAVE: miniplaca de ortodoncia, minitornillo de ortodoncia, dispositivo de anclaje temporal, dispositivo de anclaje óseo, retracción maxilar de anclaje óseo (BAMP), anclaje esquelético.

INTRODUCCIÓN

Entre los dispositivos, de titanio o sus aleaciones, para anclaje esquelético se pueden destacar tres principales: implantes oseointegrados, mini-implantes y miniplacas (Sekima *et al*., 2009). Los últimos 2, se encuentran dentro de los no osteointegrados, ya que se diseñan para uso temporal y/o sólo para la fijación de dos segmentos óseos, por lo que el acabado de la superficie lisa y pulida sumado a contaminantes propios de la fabricación, inhiben la oseointegración (Erverdi & Üsümez, 2010).

Generalidades de las miniplacas. "Miniplaca" es una placa de titanio con agujeros que permiten la colocación de minitornillos para su fijación en el hueso cortical del maxilar o mandíbula.

En Ortodoncia se utilizan como dispositivo de anclaje óseo temporal (TAD) para la realización de algunos movimientos dentarios, teniendo la particularidad de permitir el uso de fuerzas ortopédicas en ellas (Cornelis & De Clerck, 2007).

Una de las principales ventajas de las miniplacas es que pueden ser colocadas en cualquier parte de la boca, con hueso alveolar y hueso basal. Sin embargo, su inserción involucra un manejo quirúrgico mayor con levantamiento de colgajo, lo que requiere de un cirujano oral (Tsui *et al*., 2012).

Tasas de éxito, estabilidad y complicaciones. Quizás la mayor ventaja de las miniplacas es su alta tasa de

[1] Ivy Meadow Lane. Apt 1H. Durham, NC, USA. 27707.
[2] Departamento del Niño y Ortopedia Dento - Maxilar, Escuela de Odontología. Universidad de Chile, Santiago, Chile.

Temporary skeletal anchorage devices: The case for miniplates

Junji Sugawara
Sendai, Japan, and Farmington, Conn

The desire to have complete control over anchorage is no doubt universal among orthodontists. About 100 years after orthodontists first started using tooth-borne anchorage for orthodontic treatment, temporary skeletal anchorage devices appeared. It was clear that orthodontics would be a completely new ball game; soon temporary skeletal anchorage devices had become indispensable modalities in modern orthodontic practices for adults. Beyond that, temporary skeletal anchorage devices are at the center of innovations of surgical orthodontics for jaw deformities and the orthopedic treatment of growing patients with skeletal disharmonies.

As temporary skeletal anchorage devices were being developed in the 1990s, 2 types were widely put into use. There were great expectations for those that could osseointegrate with bone. This type included retromolar implants,[1,2] palatal implants,[3] and mini-implants.[4] The other type, developing in parallel, was the mechanical retention type and included miniplates[5-7] and miniscrews.[8] Extensive clinical experience for a wide range of orthodontic problems and detailed evaluations of these modalities over the years have brought us to where we are now: the temporary skeletal anchorage devices in use are miniplates and miniscrews, and both offer mechanical retention.

These 2 types of devices actually function best when they are working in collaboration with each other. They function differently, but both are indispensible in cutting-edge orthodontic treatment. Although the focus of this Counterpoint article is on miniplates, miniscrews also have a valuable role in modern orthodontics.

Director, SAS Orthodontic Center, Ichiban-Cho Dental Clinic, Sendai, Japan; visiting clinical professor, Division of Orthodontics, Department of Craniofacial Science, School of Dental Medicine, University of Connecticut, Farmington, Conn.
Address correspondence to: Junji Sugawara, SAS Orthodontic Center, Ichiban-Cho Dental Clinic, 1-35-5F Hasekura-machi, Aoba-ku, Sendai 980-0824, Japan; e-mail, j.sugawara@shika1.com.
Am J Orthod Dentofacial Orthop 2014;145:558-65
0889-5406/$36.00

http://dx.doi.org/10.1016/j.ajodo.2014.03.010

STRUCTURE OF MINIPLATES

Miniplates are made of titanium or titanium alloys and come in various shapes and sizes. All miniplates have 3 parts: head, arm, and body. The head portion is intraorally exposed and positioned outside the dental arches. The head comes in a variety of shapes: circular,[9] hooked,[10-12] and tubular.[13,14] Some are like bendable sticks that can be manipulated into the desired shape.[15] The arm portion is transgingival or transmucosal and tends to be rectangular or round. The body portion is positioned subperiosteally, and its surface is attached to the bone. The body portions are classified into 4 basic shapes: T, L, Y, and I (straight). The body portion is fixed on the bone surface of the zygomatic buttress or the mandibular body with 2 or 3 miniscrews. Although there are many variations in miniplate heads, there are fewer variations in the body portions.

SUCCESS RATES AND STABILITY

Perhaps the greatest advantage of miniplates is their high success rate. In a systematic review of temporary skeletal anchorage devices by Schätzle et al,[16] the average failure rates of various devices were 7.3% for miniplates, 10.5% for palatal implants, and 16.4% for miniscrews. The authors concluded that based on the available evidence in the literature, miniplates provided reliable absolute orthodontic anchorage. In another report, Nagasaka et al[17] reported that just 3 of 107 miniplates had to be replaced; this is equivalent to a failure rate of 2.8%. In another report by Choi et al,[18] an average failure rate of 7% was reported for miniplates. The failure rates of miniplates were 6% according to Takaki et al[19] and just 3% in a study by De Clerck and Swennen[20] when miniplates were used as bone-anchored maxillary protraction for growing Class III patients. Clearly, although the numbers vary, all of these reports indicate the overwhelming success of miniplates, whether used in the maxilla or the mandible.

Since miniplates are made of pure titanium or titanium alloy, they exhibit onplant effects on the bone surface, and the screws inserted into the cortical bone exhibit implant effects in addition to the mechanical retention effects. This means that in addition to their

A review of the literature
Revue de littérature

The benefits of using anchorage miniplates. Are they compatible with everyday orthodontic practice?

Intérêt de l'utilisation des plaques d'ancrage. Sont-elles compatibles avec une pratique orthodontique quotidienne ?

Benoît THÉBAULT[a,*], Nicolas BÉDHET[b], Marc BÉHAGHEL[b], Karim ELAMRANI[b]

[a] 14, boulevard de la Liberté, 35600 Redon, France
[b] Unité de chirurgie maxillofaciale et chirurgie plastique de la face, CHP Saint-Grégoire, 6, boulevard de la Boutière, 35760 Saint-Grégoire, France

Available online: 17 November 2011 / Disponible en ligne : 17 novembre 2011

Summary

Nowadays, it is difficult to ignore the major role played by orthodontic anchorage. Given our convictions and after several years of using these systems, we believe it is time to take stock. Is there any real benefit to using them? And if so, when? What systems should we use? Miniscrews or miniplates? What are the indications for each of these systems? Are they compatible with everyday orthodontic practice? In a nutshell, are these orthodontic anchorage devices myth or practical reality?

Key-words

- Orthodontics.
- Anchorage.
- Miniscrews.
- Anchorage miniplates.
- Delaire analysis.

Résumé

Il semble aujourd'hui difficile d'ignorer l'importance des ancrages orthodontiques. Compte tenu de nos convictions et après plusieurs années d'utilisation de ces systèmes, un bilan s'impose. Y a-t-il un intérêt réel à les utiliser ? Si oui, quand les utiliser ? Quels systèmes employer ? Minivis ou miniplaques ? Quelles sont les indications de chacun ? Ces systèmes sont-ils compatibles avec une utilisation quotidienne en orthodontie ? Au total, ces ancrages orthodontiques sont-ils un mythe ou une réalité applicable ?

Mots-clés

- Orthodontie.
- Ancrage.
- Minivis.
- Plaques d'ancrage.
- Analyse de Delaire.

* **Correspondence and reprints / Correspondance et tirés à part.**
e-mail address / Adresse e-mail : Benoit.Thebault@wanadoo.fr (Benoît Thébault)

Original Article

Success rates of a skeletal anchorage system in orthodontics: *A retrospective analysis*

Raymond Lam[a]; Mithran S. Goonewardene[b]; Brent P. Allan[c,d]; Junji Sugawara[e,f]

ABSTRACT

Objectives: To evaluate the premise that skeletal anchorage with SAS miniplates are highly successful and predictable for a range of complex orthodontic movements.

Materials and Methods: This retrospective cross-sectional analysis consisted of 421 bone plates placed by one clinician in 163 patients (95 female, 68 male, mean age 29.4 years ± 12.02). Simple descriptive statistics were performed for a wide range of malocclusions and desired movements to obtain success, complication, and failure rates.

Results: The success rate of skeletal anchorage system miniplates was 98.6%, where approximately 40% of cases experienced mild complications. The most common complication was soft tissue inflammation, which was amenable to focused oral hygiene and antiseptic rinses. Infection occurred in approximately 15% of patients where there was a statistically significant correlation with poor oral hygiene. The most common movements were distalization and intrusion of teeth. More than a third of the cases involved complex movements in more than one plane of space.

Conclusions: The success rate of skeletal anchorage system miniplates is high and predictable for a wide range of complex orthodontic movements. (*Angle Orthod.* 0000;00:000–000.)

KEY WORDS: Orthodontic anchorage; Bone plate; Skeletal anchorage; Miniplate

INTRODUCTION

Temporary skeletal anchors have become a routine component of the contemporary orthodontists' clinical armamentarium. The clinician can use them to develop force systems directly from the device and/or prevent unwanted side effects by indirectly connecting the device to dental anchor units. The range of force application has extended beyond historical antero-posterior movements to include more complex vertical and transverse movements previously considered problematic. In addition, these devices do not rely on patient compliance and do not affect aesthetics, which is a major disadvantage with the traditional headgear or facemask. The stability of these devices makes it possible to obtain complete anchorage to address the wide range of reciprocal forces in orthodontic mechanotherapy.

Historically, temporary anchors were first documented in the early 1980s by placing a surgical fixation screw in the maxillary alveolus to support direct force to the dentition.[1] Similarly, Roberts et al.[2] demonstrated the application of osseointegrated implants as indirect anchorage to protract posterior teeth in the mandible. Following these reports, numerous applications of osseointegrated fixtures were demonstrated.[3] Notably, Konomi[4] reported intrusion of anterior teeth using an osseointegrated mini bone screw 1.2 mm in diameter and 6 mm in length.[4] This generated great interest in small microscrews as a source of orthodontic anchorage.

[a] Research Fellow, Department of Orthodontics, Dental School, The University of Western Australia, Nedlands, Western Australia, Australia.

[b] Program Director, Department of Orthodontics, Dental School, The University of Western Australia, Nedlands, Western Australia, Australia.

[c] Private Maxillofacial Surgical Practice, Perth, Australia.

[d] Consultant to the Department of Orthodontics, Dental School, The University of Western Australia, Nedlands, Western Australia, Australia.

[e] Visiting Clinical Professor, Department of Craniofacial Sciences, Division of Orthodontics, University of Connecticut School of Dental Medicine, Farmington, CT, USA.

[f] Chief, SAS Orthodontic Center, Ichiban-Cho Dental Clinic, Sendai, Japan.

Corresponding Author: Mithran S. Goonewardene, Program Director, Orthodontics, Dental School, The University of Western Australia, 17 Monash Avenue, Nedlands 6009, Western Australia, Australia
(e-mail: mithran.goonewardene@uwa.edu.au)

Accepted: August 2017. Submitted: June 2017.
Published Online: October 20, 2017

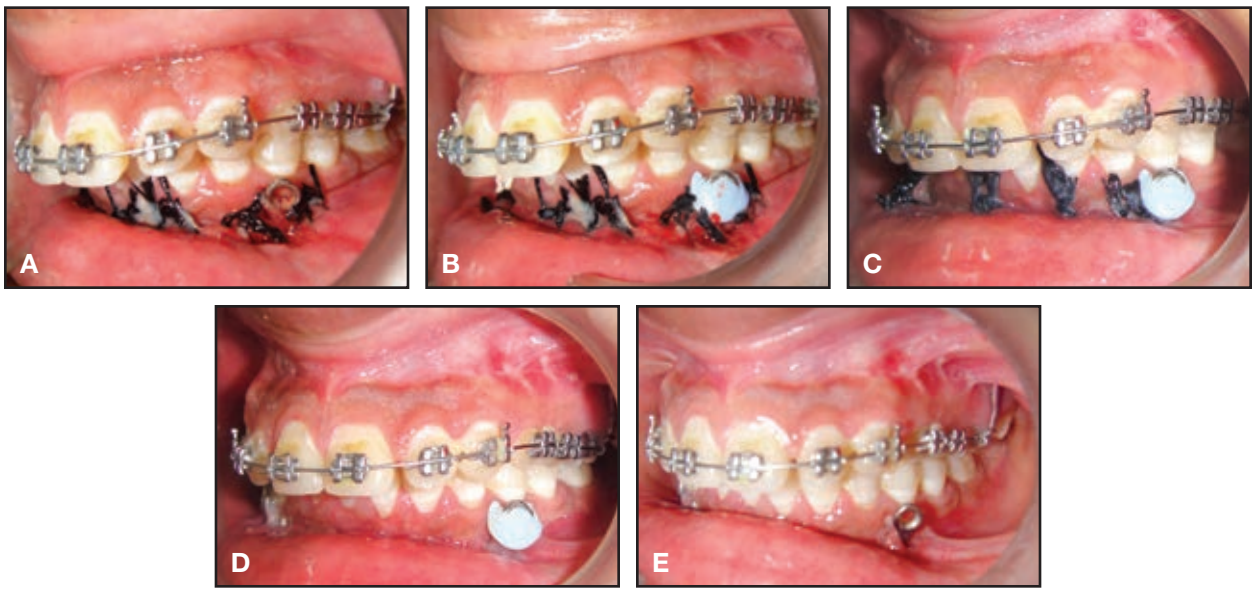
PEARLS

Putty Pack for Prevention of Soft-Tissue Overgrowth Around Surgical Miniplates

One of the main reasons why clinicians tend to prefer miniscrews over miniplates for skeletal anchorage is the development of soft-tissue overgrowth around miniplate insertion sites, due to chronic irritation from local plaque accumulation and consequent inflammation.[1,2] In our experience, such overgrowth is most prevalent around the free arm of a miniplate in the lower arch, even when oral hygiene is good.

An inflammatory reaction can be prevented by covering the free arm with a periodontal dressing such as Coe-Pak,* Barricaid,** or Peripac*** immediately after surgical placement.[3,4] These materials are designed to disintegrate within a week, however, and orthodontic forces are not usually applied until two to three weeks after miniplate insertion.[5]

As an alternative, we tried a common soft-putty impression material (Aquasil***). In the case shown here, miniplates were placed between the root apices of the lower lateral incisors and canines, with the free arms extending through the



*Trademark of GC America, Inc., Alsip, IL; www.gcamerica.com.
**Registered trademark of Dentsply Caulk, Milford, DE; www.caulk.com.
***Dentsply Caulk, Milford, DE; www.caulk.com.

Modified Miniplates for Temporary Skeletal Anchorage in Orthodontics: Placement and Removal Surgeries

*Marie A. Cornelis, DDS, PhD, MS,**
Nicole R. Scheffler, DDS, MS,† Pierre Mahy, DDS, MD,‡
Sergio Siciliano, DDS, MD,§ Hugo J. De Clerck, DDS, PhD,‖
and J.F. Camilla Tulloch, BDS, FDS, DOrth¶

Purpose: Skeletal anchorage systems are increasingly used in orthodontics. This article describes the techniques of placement and removal of modified surgical miniplates used for temporary orthodontic anchorage and reports surgeons' perceptions of their use.

Patients and Methods: We enrolled 97 consecutive orthodontic patients having miniplates placed as an adjunct to treatment. A total of 200 miniplates were placed by 9 oral surgeons. Patients and surgeons completed questionnaires after placement and removal surgeries.

Results: Fifteen miniplates needed to be removed prematurely. Antibiotics and anti-inflammatories were generally prescribed after placement but not after removal surgery. Most surgeries were performed with the patient under local anesthesia. Placement surgery lasted on average between 15 and 30 minutes per plate and was considered by the surgeons to be very easy to moderately easy. The surgery to remove the miniplates was considered easier and took less time. The patients' chief complaint was swelling, lasting on average 5.3 ± 2.8 days after placement and 4.5 ± 2.6 days after removal.

Conclusions: Although miniplate placement/removal surgery requires the elevation of a flap, this was considered an easy and relatively short surgical procedure that can typically be performed with the patient under local anesthesia without complications, and it may be considered a safe and effective adjunct for orthodontic treatment.

J Oral Maxillofac Surg 66:1439-1445, 2008

One of the most challenging problems in orthodontics is to find sufficient anchorage to achieve planned tooth movements. Conventional approaches take advantage of the differential anchorage potential in the dentition, where a larger number of teeth can resist movement of a smaller number. This often requires the additional use of compliance-dependent auxiliary devices such as intermaxillary elastics and/or headgear. In many adult patients with partial or periodontally compromised dentition, the available anchorage is further reduced. To widen orthodontic treatment possibilities or reduce the need for compliance-dependent devices, first prosthetic implants[1] and later retromolar[2] and palatal implants[3] were incorporated into orthodontic treatment. These devices are relatively expensive, require a healing period before orthodontic loading, and often provide only indirect anchorage. More recently, temporary skeletal anchorage

*Consultant, Experimental Morphology Unit and Department of Orthodontics, Université Catholique de Louvain, Brussels, Belgium.

†Private Practice, Boone, NC, and Adjunct Assistant Professor, Department of Orthodontics, University of North Carolina, Chapel Hill, NC.

‡Consultant, Department of Oral and Maxillofacial Surgery, Université Catholique de Louvain, Cliniques Universitaires St-Luc, Brussels, Belgium.

§Private Practice and Clinique Ste-Elisabeth, Brussels, Belgium.

‖Private Practice, Brussels, Belgium; and Adjunct Professor, University of North Carolina, Chapel Hill, NC.

¶Professor and Chair, Department of Orthodontics, University of North Carolina, Chapel Hill, NC.

This study was supported in part by a grant from the Southern Association of Orthodontics, Dental Foundation of the University of North Carolina, and Fonds Spéciaux de Recherche 2004 from the Université Catholique de Louvain.

Address correspondence and reprint requests to Dr Cornelis: Experimental Morphology Unit, Université Catholique de Louvain, Av Mounier, 52/5251, 1200 Brussels, Belgium; e-mail: marie.cornelis@uclouvain.be

0278-2391/08/6607-0017$34.00/0
doi:10.1016/j.joms.2008.01.037

ORIGINAL ARTICLE

Factors associated with the stability of titanium screws placed in the posterior region for orthodontic anchorage

Shouichi Miyawaki, DDS, PhD,[a] Isao Koyama, DDS, PhD,[b] Masahide Inoue, DDS,[a] Katsuaki Mishima, DDS, PhD,[c] Toshio Sugahara, DDS, PhD,[c] and Teruko Takano-Yamamoto, DDS, PhD[a]

Okayama and Nara, Japan

Recently, implant anchors such as titanium screws have been used for absolute anchorage during edgewise treatment. However, there have been few human studies reporting on the stability of implant anchors placed in the posterior region. The purpose of this study was to examine the success rates and to find the factors associated with the stability of titanium screws placed into the buccal alveolar bone of the posterior region. Fifty-one patients with malocclusions, 134 titanium screws of 3 types, and 17 miniplates were retrospectively examined in relation to clinical characteristics. The 1-year success rate of screws with 1.0-mm diameter was significantly less than that of other screws with 1.5-mm or 2.3-mm diameter or than that of miniplates. Flap surgery was associated with the patient's discomfort. A high mandibular plane angle and inflammation of peri-implant tissue after implantation were risk factors for mobility of screws. However, we could not detect a significant association between the success rate and the following variables: screw length, kind of placement surgery, immediate loading, location of implantation, age, gender, crowding of teeth, anteroposterior jaw base relationship, controlled periodontitis, and temporomandibular disorder symptoms. We concluded that the diameter of a screw of 1.0 mm or less, inflammation of the peri-implant tissue, and a high mandibular plane angle (ie, thin cortical bone), were associated with the mobility (ie, failure) of the titanium screw placed into the buccal alveolar bone of the posterior region for orthodontic anchorage. (Am J Orthod Dentofacial Orthop 2003;124:373-8)

It is no exaggeration to say that anchorage in edgewise treatment is the most important factor that affects the treatment plan and result. Until now, various techniques to reinforce anchorage have been devised and used in orthodontic practice. Recently, several kinds of implant anchors providing absolute anchorage have attracted the attention of orthodontists.[1,2] Among them, titanium screws, which were originally used for intermaxillary or bone fixation, have the following advantages: minimal anatomic limitation for placement, lower medical cost, simpler placement surgery, and less discomfort after implantation when compared with dental implants for abutment.[3,4] Therefore, titanium screws of various sizes have gradually come to be used for orthodontic absolute anchorage.[1,5-9] However, there have been few human studies in which the success rates for various kinds of implant anchors were examined.

With respect to dental implants for abutment, it was reported that the success rate is approximately 97% and that the factors decreasing their stability are patient age of more than 40 years, implant design and material such as alloy basket and hydroxyapatite-coated cylinder, lower bone density, placement in posterior region in the jaw, and use of a bone tap.[10] Furthermore, it is well known that inflammation of the peri-implant tissue causes peri-implant bone loss, leading to implant mobility.[11,12] However, most orthodontic patients are less than 40 years old and have relatively high bone density, and titanium screws have often been used for orthodontic anchorage in the posterior region.[1,7-9] Therefore, several factors affecting dental implant stability might not be associated with the stability of implant anchors.

According to recent reports on implant anchors in humans,[1,13] titanium screws have occasionally been removed because of their mobility before or during orthodontic force application. Thus, the orthodontist

[a]Department of Orthodontics, Okayama University Graduate School of Medicine and Dentistry, Okayama, Japan.
[b]Koyama Orthodontic Clinic, Nara, Japan.
[c]Department of Oral and Maxillofacial Reconstructive Surgery, Okayama University Graduate School of Medicine and Dentistry.
This study was partially supported by the Japan Society for the Promotion of Science in the form of Grants-in-Aid for Scientific Research (#13672149 and #20322232).
Reprint requests to: Teruko Takano-Yamamoto, Okayama University Graduate School of Medicine and Dentistry, Department of Orthodontics, 2-5-1, Shikata-cho, Okayama, 700-8525 Japan; e-mail, t_yamamo@md.okayama-u.ac.jp.
Submitted, October 2002; revised and accepted, December 2002.

0889-5406/2003/$30.00 + 0
doi:10.1016/S0889-5406(03)00565-1

HEAD & FACE MEDICINE

METHODOLOGY Open Access

Fully customized placement of orthodontic miniplates: a novel clinical technique

Jan Hourfar[1], Georgios Kanavakis[2*], Peter Goellner[3] and Björn Ludwig[4]

Abstract

Introduction: The initial stability and survival rate of orthodontic mini-implants are highly dependent on the amount of cortical bone at their insertion site. In areas with limited bone availability, mini-plates are preferred to provide effective skeletal anchorage. The purpose of this paper was to present a new clinical technique for the insertion of mini-plates.

Methods: In order to apply this new technique, a cone-beam image of the insertion area is required. A software (Galaxy Sirona, Bensheim, Germany) is used to construct a three-dimensional image of the scanned area and to virtually determine the exact location of the mini-plate as well as the position of the fixation screws. A stereolithographic model (STL) is then created by means of a three-dimensional scanner.
Prior to its surgical insertion, the bone plate is adapted to the stereo-lithographic model. Finally, a custom transfer jig is fabricated in order to assist with accurate placement of the mini-plate intra-operatively.

Results: The presented technique minimizes intra-operative decision making, because the final position of the bone plate is determined pre-surgically. This significantly reduces the duration of the surgical procedure and improves its outcome.

Conclusions: A novel method for surgical placement of orthodontic mini-plates is presented. The technique facilitates accurate adaptation of mini-plates and insertion of retaining surgical screws; thereby enabling clinicians to more confidently increase the use of bone plates, especially in anatomical areas where the success of non-osseointegrated mini-screws is less favorable.

Introduction

Orthodontic mini-implants (MIs) have gained popularity among orthodontists mainly because they provide an effective tool in orthodontic cases with high anchorage demands. However, there are several factors affecting the survival rate of the implants that need to be taken into consideration prior to their insertion [1]. Previous literature has emphasized the significance of cortical bone thickness for initial stability of orthodontic mini-implants [2-4].

Clinical investigations assessing quality and quantity of alveolar bone in the maxilla and the mandible revealed that there are not many areas of sufficient bone quality able to guarantee successful placement of MIs [5-9].

A particularly challenging area is the anterior mandible. For cases that require unilateral or bilateral protraction of mandibular posterior teeth, placement of a skeletal anchorage device around the canine area can provide suitable possibilities supporting treatment mechanics. However, the only inter-radicular spaces in the mandible presenting adequate bone quality and quantity are distal to the first premolars [9]. Moreover, insertion of mini-implants in the mandibular canine region is not recommended in patients younger than 11 years of age, because of incomplete bone maturation and due to increased risk of interrupting normal eruption of the permanent canine [10,11].

In order to overcome the above-mentioned limiting factors, orthodontic mini-plates can be recommended as anchorage devices. The introduction of mini-plates in orthodontics has further enhanced treatment possibilities for complex orthodontic and orthopedic problems [12]. There are numerous reports in the literature proposing

* Correspondence: gkanavak@gmail.com
[2]Department of Orthodontics and Dentofacial Orthopedics, Tufts University School of Dental Medicine, 1 Kneeland Street DHS#1145, Boston, MA, USA
Full list of author information is available at the end of the article

Bull Tokyo Dent Coll (2010) 51(3): 151–163

Original Article

Clinical Study of Temporary Anchorage Devices for Orthodontic Treatment —Stability of Micro/Mini-screws and Mini-plates: Experience with 455 Cases—

Takashi Takaki, Naoki Tamura, Masae Yamamoto, Nobuo Takano, Takahiko Shibahara, Toshihiko Yasumura*, Yasushi Nishii* and Kenji Sueishi*

Department of Oral and Maxillofacial Surgery, Tokyo Dental College, 1-2-2 Masago, Mihama-ku, Chiba 261-8502, Japan
** Department of Orthodontics, Tokyo Dental College, 1-2-2 Masago, Mihama-ku, Chiba 261-8502, Japan*

Received 26 March, 2010/Accepted for publication 12 May, 2010

Abstract

The aim of this retrospective study was to determine factors that might cause complications in use of temporary anchorage devices (TADs) for orthodontic anchorage. We investigated 904 TADs in 455 patients. Clinical diagnoses requiring orthodontic treatment were malocclusion, jaw deformity, various syndromes, cleft lip and palate and impacted teeth. All patients underwent surgery at Tokyo Dental College Chiba Hospital between November 2000 and June 2009. Three kinds of titanium screw of different diameter and length were used: self-drilling mini-screws (Dual Top Autoscrew® and OSAS®), pre-drilling micro-screws (K1 system®) and palatal screws (PIAS®). Mini-plates fixed with 2 or 3 screws (SAS system®) were also used for skeletal anchorage. Patients were aged between 8 and 68 years (25.7 ± 9.8 years). A total of 460 screw-type and 444 plate-type TADs were used. These comprised the following: mini-plates, 444; self-drilling mini-screws, 225; pre-drilling micro-screws, 83; and palatal screws, 152. Each type of implant had a high success rate of over about 90%. Failure rates were as follows: micro-screws, 7%; mini-screws, 6%; palatal implants, 11%; and mini-plates, 6%. Inflammation rate occurring in soft tissue surrounding TADs was follows: plate-type, 7.6%; mini-screws, 1.3%; micro-screws, 0%; and palatal implants, 2.5%. Inflammation frequencies depended on degree of mucosal penetration. Granulation rate in soft tissue surrounding TADs occurred as follows: micro-screws, 5.7%; self-drilling mini-screws, 0%; palatal screws, 0.6%; plate-type, 0.9%. Both plate- and screw-type orthodontic implants showed excellent clinical performance.

Key words: Anchorage—TADs—Micro-implant—Mini-implant—SAS

Introduction

Orthodontic anchorage is an important factor in obtaining good treatment results. Stable anchorage is a pre-requisite for orthodontic treatment with fixed appliances. Traditional

Original Article

Surgical Difficulties, Success, and Complication Rates of Orthodontic Miniplate Anchorage Systems: Experience with 382 Miniplates

Y Findik, T Baykul, E Esenlik[1], MH Turkkahraman[1]

Departments of Oral and Maxillofacial Surgery and [1]Orthodontics, Faculty of Dentistry, Süleyman Demirel University, Isparta, Turkey

Abstract

Purpose: The aim of this study was to evaluate the complications and success rates of the miniplates using both maxilla and mandible for orthodontic anchorage in growing patients. **Materials and Methods:** One hundred and fifty-five consecutive patients (range 8.7–13.8 years) with Class II and III malocclusion without congenital or acquired deformities were included in this study. A total of 382 titanium miniplates were placed by the same surgeon. All miniplates were inserted under local anesthesia. Loading of the miniplates with a force of 200 g with the help of elastics or functional devices were initiated 3 weeks after surgery. **Results:** The overall success rate of miniplate anchorage in terms of stability was 96.8%. Twenty-one patients reported irritation of the mucosa of the cheeks or lower lip after the surgery in the mandible group. Twelve miniplates needed to be removed and were successfully replaced. **Conclusion:** Skeletal anchorage miniplates is effective for correcting malocclusions. Success depends on proper presurgical patient counseling, minimally invasive surgery, good postsurgical instructions, and orthodontic follow-up.

Keywords: *Miniplates, oral surgery, orthodontic anchorage*

Date of Acceptance:
02-Dec-2015

Introduction

Conventional orthodontics for the treatment of dental and facial skeletal discrepancies often involves intraoral appliances and extraoral appliances. In situations in which patients are partially edentulous or have oligodontia, the lack of teeth can often pose challenges for the orthodontist in devising a treatment plan with the existing dentition to provide sufficient anchorage.[1] Orthodontic anchorage is a term which explains the nature and degree of resistance to displacement offered by an anatomic unit. Anchorage is one of the important and factors in orthodontics, and its control is essential for successful treatment outcomes.[2] Implants and miniplates placed into the maxillo-mandibular skeleton enable the orthodontist to provide additional anchorage and exert predictable force in all three spatial planes transverse, vertical, and sagittal. There is a vast amount of literature on the use of anchorage devices in orthodontics to treat Class II and III malocclusion, malaligned teeth by uprighting, extrusion, intrusion, mesialization, and distalization. Traditionally, orthodontic therapy use teeth, extraoral and/or intermaxillary appliances for anchorage. For orthodontic anchorage, orthodontic implants (retromolar implants, miniscrews, pins, and palatal onplants) miniplates, fixation wires have been used frequently.[3] Over several years, bone-anchored orthodontic chin movement without corticotomy or osteotomy with the use of orthodontic elastics between miniplates in the upper and lower jaw was introduced.[4] Usually, different kinds of miniplates are inserted between the lateral and canine region in the mandible and the first molar region in the maxilla for skeletal anchorage for the treatment of various malocclusions. On the other hand, several problems such as loosening of the plates, inflammation, soft tissue changes, and fractures of the plates may be encountered during the surgical and orthodontic

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/1119-3077.187320

Address for correspondence: Dr. Y Findik, Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Süleyman Demirel University, Isparta, Turkey.
E-mail: yavuzfindik32@hotmail.com

How to cite this article: Findik Y, Baykul T, Esenlik E, Turkkahraman MH. Surgical difficulties, success, and complication rates of orthodontic miniplate anchorage systems: Experience with 382 miniplates. Niger J Clin Pract 2017;20:512-6.

Distalization of the mandibular dentition with a ramal plate for skeletal Class III malocclusion correction

Yoon-Ah Kook,[a] Jae Hyun Park,[b] Mohamed Bayome,[c] Sungkon Kim,[d] Eugene Han,[e] and Chang Hyen Kim[f]
Seoul, Korea, Mesa, Ariz, Asunción, Paraguay, and Los Angeles, Calif

The retromolar fossa is an anatomically suitable skeletal anchorage site. The aim of this report was to introduce a novel appliance for the correction of skeletal Class III malocclusions with mandibular dentition distalization. The placement site and the procedure of the ramal plate are described. The resulting force vectors are parallel to the functional occlusal plane leading to efficient molar distalization. This approach is demonstrated with 2 adult patients who refused a surgical treatment option. This ramal plate may be indicated for total arch distalization for nonextraction and nonsurgical cases. (Am J Orthod Dentofacial Orthop 2016;150:364-77)

A severe anteroposterior skeletal discrepancy in a patient with a Class III malocclusion is generally treated with orthognathic surgery. However, a mild to moderate skeletal Class III malocclusion can be treated by either surgery or camouflage.[1,2] Traditionally, patients who were reluctant to undergo surgical procedures to improve their Class III dental relationships turned to camouflage orthodontic treatment with different extraction patterns according to the proclination of the mandibular incisors and the amount of negative overjet.[3-5]

Recently, temporary skeletal anchorage devices (TSADs) have decreased the need for extractions and surgical procedures.[6-11] Previous studies have reported the achievement of 4 to 5 mm of mandibular molar distalization using miniscrews in the retromolar area.[6,7] Distalization of the mandibular molars enables retraction of the incisors to achieve a positive overjet. Other studies have reported successful mandibular total arch distalization using stainless steel miniscrews placed in the buccal shelf.[12,13]

Miniplates can withstand the higher forces required to distalize the whole dentition, unlike miniscrews.[14] Sugawara et al[15] reported the use of miniplates for mandibular distalization, and they placed the miniplates on the mandibular body. In contrast, our ramal plates are installed medial to the anterior border of the ramus because the force vector might be more favorable from the retromolar area for some patients because it is more parallel to the functional occlusal plane.

Therefore, the purpose of this article is to introduce placement of a ramal plate in the retromolar fossa as a novel approach to efficient mandibular total arch distalization.

A ramal plate is placed in the retromolar fossa, located between the anterior border of the mandibular ramus and the temporal crest (Fig 1).[16] After doing the flap in the retromolar area, the L-plate (LeForte System; Jeil Medical, Seoul, Korea; length of the short arm, 10 mm; length of the long arm, 15.5 or 22 mm; diameter, 2.5 mm) is adapted to fit the bone surface. The third molars are extracted during the procedure. The anterior hole of the plate that extends into the oral cavity is positioned horizontally to be 3 mm lateral to the buccal surface of the second molar, and between the buccal groove of the second molar and its distal surface, anteroposteriorly (Fig 2).

The plates are fixated with 2 screws (with pilot drilling), 2 mm in diameter, 5 mm in length. The flap is sutured (usually 2 sutures) over the plate, and the

[a]Professor, Department of Orthodontics, Seoul St. Mary's Hospital, Catholic University of Korea, Seoul, Korea.
[b]Professor and chair, Postgraduate Orthodontic Program, Arizona School of Dentistry & Oral Health, A. T. Still University, Mesa, Ariz; adjunct professor, Graduate School of Dentistry, Kyung Hee University, Seoul, Korea.
[c]Research assistant professor, College of Medicine, Catholic University of Korea, Seoul, Korea; visiting professor, Department of Postgraduate Studies, Universidad Autonóma del Paraguay, Asunción, Paraguay.
[d]Resident, Department of Orthodontics, Seoul St. Mary's Hospital, Catholic University of Korea, Seoul, Korea.
[e]Resident, Department of Orthodontics, University of Southern California, Los Angeles, Calif.
[f]Associate professor, Department of Oral and Maxillofacial Surgery, Seoul St. Mary's Hospital, Catholic University of Korea, Seoul, Korea.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
This study was partly supported by the fund of the Department of Orthodontics, Graduate School of Clinical Dental Science, Catholic University of Korea.
Address correspondence to: Yoon-Ah Kook, Department of Orthodontics, Seoul St. Mary's Hospital, Catholic University of Korea, 222 Banpo-daero, Seocho-Gu, Seoul 137-701, Korea; e-mail, kook190036@yahoo.com.
Submitted, September 2015; revised and accepted, March 2016.
0889-5406/$36.00

http://dx.doi.org/10.1016/j.ajodo.2016.03.019

Closure of Severe Skeletal Anterior Open Bite With Zygomatic Anchorage

Laszlo Seres, MD, and Andras Kocsis, DDS†*

Abstract: An open bite is commonly one of the main symptoms of an overall dentofacial deformity. Most anterior open-bite cases are characterized by excessive vertical development of the posterior maxilla. Intrusion of the overerupted molar teeth by traditional orthodontic methods is hardly possible; there is therefore no real alternative to a combined orthodontic and surgical approach. Skeletal anchorage has recently been proposed for the orthodontic movement of teeth. Titanium miniplates implanted in the zygomatic buttress area can serve as the absolute anchorage for maxillary molar intrusion. The aim of this study was to evaluate the use of skeletal anchorage for the closing of open-bite malocclusions. Seven patients with severe anterior open bites were selected, in all of whom the deformity was due to overeruption of the maxillary molars. Titanium miniplates were inserted bilaterally in the zygomatic buttress region and fixed with miniscrews. Elastic bands or coil springs were used to reduce excessive maxillary molar heights. In all cases, the anterior open bite improved significantly. The mean duration of active treatment was 6 months. No significant side effects were observed. Our results show that skeletal anterior open bites due to posterior maxillary dentoalveolar hyperplasia can be closed with intrusion of the upper molar teeth. This method is a safe, quick, and less expensive alternative to orthognathic surgery.

Key Words: Skeletal anchorage, titanium miniplates, skeletal open bite, intrusion of molar teeth

(*J Craniofac Surg* 2009;20: 478–482)

An open bite is commonly one of the main symptoms of an overall dentofacial deformity. Most cases of anterior open bite are characterized by overeruption of the maxillary molars.[1] In young patients, the vertical maxillary growth can be controlled with a high-pull headgear or a functional appliance with bite blocks. Once excessive vertical development of the posterior maxilla has occurred, only 2 treatment options are available for the correction of an open bite. Elongation of the anterior teeth leaves the skeletal component of the deformity unchanged. When orthodontic or surgical intrusion of the overerupted maxillary teeth is performed, the mandible rotates closed at rest and in function, resulting in open-bite closure.[2] Intrusion of the molar teeth with traditional orthodontic methods is hardly possible. Multiloop edgewise archwire has been recommended for open-bite closure in nongrowing patients, but with this approach, the correction was achieved mainly through extrusion of the incisors without skeletal changes.[3,4] Carano et al[5] recently reported rapid molar intrusion with an appliance consisting of 2 elastic modules. Their initial clinical experience was promising, but the number of treated nongrowing patients was not reported. Furthermore, the rapid molar intrusion device reportedly tended to undergo permanent deformation, and the replacement of these modules complicates the treatment procedure.

Until recently, there was no orthodontic approach for the predictable intrusion of molar teeth in nongrowing patients. Skeletal anchorage has recently been suggested for the orthodontic movement of teeth.[6–8] The studies by Ohmae et al[9] with an animal model and by Umemori et al[10] in humans demonstrated the effective intrusion of mandibular molars when titanium miniplates were used for anchorage. Erverdi et al[11–13] proposed the zygomatic buttress area as an anchorage site for maxillary molar intrusion and reported the closure of anterior open bites[12] and successful correction of a severe overjet problem with this method.[13] Sherwood et al[14,15] intruded maxillary molars with miniplate anchorage. Yao et al[16] made use of a mini-implant anchorage system for the intrusion of overerupted maxillary molar teeth.

The aim of the current study was to evaluate the role of titanium reconstruction miniplates as temporary skeletal anchorage in the management of severe anterior open bites.

MATERIALS AND METHODS

Seven patients (4 women and 3 men) with severe anterior open bites who applied for orthodontic treatment at our Department of Dentistry and Oral Surgery were selected. The average age of the patients at the beginning of treatment was 21 years (range, 15–29 years). In all cases, the deformity was due to overeruption of the maxillary molars. The mean anterior open bite measured between the edges of the incisors in the vertical plane was 6 mm (range, 4–11 mm). Four patients exhibited class I occlusion, whereas 2 individuals presented with a class II and 1 with a class III malocclusion.

Transpalatal Arch

Before implantation of the skeletal anchors, the molars were separated, and the molar bands were adapted.[17] Intrusion of the molars by means of a force directed only apically to the buccal tooth attachment would result in adverse buccal tipping. To avoid this, the molars were connected with 2 transpalatal arches (TPAs). A Goshgarian transpalatal bar was bent from a 0.036-in (0.9 mm) stainless steel wire so as to extend from the maxillary first molar, along the contour of the palate, to the maxillary first molar on the opposite side. Another 5 × 1-mm, prefabricated, cobalt-chrome alloy TPA was soldered to the palatal aspects of the second molar bands (Fig. 1). The soldered TPA prevented torque and tipping of the molars until the mesiodistal and orovestibular angulation was

From the Departments of *Oral and Maxillofacial Surgery and †Orthodontics, University of Szeged, Hungary.
Received May 13, 2008.
Accepted for publication May 31, 2008.
Address correspondence and reprint requests to Laszlo Seres, MD, Department of Oral and Maxillofacial Surgery, University of Szeged, Kalvaria sgt. 57, Szeged, Hungary, 6725; E-mail: SERESL@yahoo.com

ISSN: 1049-2275
DOI: 10.1097/SCS.0b013e31819bd161

Oral Maxillofac Surg
DOI 10.1007/s10006-013-0430-5

REVIEW ARTICLE

Orthodontic treatment of anterior open bite: a review article—is surgery always necessary?

Isabelle Reichert · Philipp Figel · Lindsay Winchester

Received: 14 May 2013 / Accepted: 29 July 2013

Abstract
Introduction Anterior open bite cases are very difficult to treat satisfactorily because of their multifactorial aetiology and their very high relapse rate. Dependent on the origin of the anterior open bite malocclusion and the patient's age, there are several treatment possibilities ranging from deterrent appliances, high-pull headgear, fixed appliances with and without extractions to orthognathic surgery, and skeletal anchorage with miniplates or miniscrews.
Methods The gold standard treatment of skeletal anterior open bite cases is the combined approach of orthodontic treatment with fixed appliances and orthognathic surgery. In recent years, temporary anchorage devices (TAD) have been developed to correct anterior open bites orthodontically. With the introduction of TAD as an effective treatment modality, orthognathic surgery may be avoidable in selected anterior open bite cases.
Conclusion This is a relatively new technique and to date there remains a lack of evidence of long-term stability of anterior open bite closure with TAD.

Keywords Anterior open bite · TAD · Orthognathic · Skeletal anchorage · Relapse

I. Reichert (✉) · L. Winchester
Orthodontic Department, Queen Victoria Hospital NHS Foundation Trust, Holtye Road, East Grinstead, West Sussex RH19 3DZ, UK
e-mail: Isabelle.reichert@gmx.de

P. Figel
School of Oral and Dental Sciences, Bristol Dental Hospital and School, University of Bristol, Lower Maudlin Street, Bristol BS1 2LY, UK

Published online: 16 August 2013

Introduction

The anterior open bite (AOB) malocclusion is one of the most challenging malocclusions to treat due to the high frequency of relapse [1–6]. It is defined as no vertical overlap of the incisors when buccal segment teeth are in occlusion. This paper aims to review and summarize the different orthodontic treatment modalities that can be used for the management of AOB as an alternative to surgery, together with the evidence for their effectiveness.

The early 1960s to the mid-1970s are called the "era of tongue thrusts," because the malocclusion was often thought to be caused by tongue thrust [6]. Before the 1970s, the orthodontic treatment mainly consisted of dentoalveolar changes and/or modification of habits [7].

AOB has a multifactorial aetiology including skeletal, dental, respiratory, neurologic, and habitual components [1, 8]. It can be broadly described as being skeletal or dental in origin [9].

A high-angle skeletal pattern with increased Frankfort Mandibular Plane Angle can lead to an AOB when the vertical component of growth disproportionally exceeds the horizontal component of growth. Labial tooth eruption cannot compensate for the increase in inter-occlusal distance with, in severe cases, only the posterior molars in occlusion. Patients with an AOB may have some or all of the following cephalometric features: pronounced ante-gonial notching, recessive chin, reduced inter-incisal angle, reduced inter-molar angle, and increased lower anterior facial height. It is believed that soft tissues also play a role in AOB. Incompetent lips might lead to a tongue thrust, to make an oral seal while swallowing, influencing the dentoalveolar position of the anterior segments by intruding them. Digit sucking often results in an AOB, by preventing vertical incisor eruption, with associated posterior cross bites caused by increased cheek pressure and lowered tongue position, resulting in narrowing of the arch. Prolonged mouth breathing due to increased tonsillar or adenoidal

Risk factors and indications of orthodontic temporary anchorage devices: a literature review

Sofie Hoste,* Marjolein Vercruyssen,† Marc Quirynen† and Guy Willems*
Departments of Orthodontics and Forensic Dentistry* and Periodontology† School of Dentistry, Katholieke Universiteit Leuven, Belgium

Aims: The aims of this review are twofold, firstly, to give an overview of the general and local risk factors when using temporary anchorage devices (TADs) and the prerequisites for placement and, secondly, to illustrate the orthodontic indications of various TADs.
Methods: The PubMed database was searched for original articles on: 'orthodontics and miniscrews/mini-implants/miniplates/temporary anchorage devices/titanium screws/skeletal anchorage', 'miniscrews/mini-implants/miniplates and risk factors/biomechanics/placement procedure'. Only articles published between 2001 and December 2007 were used. In addition, each article was hand searched for references that may have been missed by the PubMed search.
Results: General risk factors are factors concerning general health. Bone quality and oral hygiene are local risk factors. Aspects of the placement procedure discussed were: primary stability, loading protocols, pre-drilling diameter and whether or not to make an intra-oral incision. A selection of published case reports is given to illustrate some orthodontic indications of TADs.
Conclusions: Temporary anchorage devices have a place in modern orthodontics. Careful treatment planning involving radiographic examination is essential. Consultation with an oral surgeon is advisable if a soft tissue flap is required. Excellent patient compliance, particularly avoidance of inflammation around the implant, is an important consideration for successful use of TADs.
(Aust Orthod J 2008; 24: 140–148)

Received for publication: July 2008
Accepted: August 2008

Introduction

Secure anchorage is a fundamental requirement for successful treatment of many malocclusions. Factors such as inadequate patient compliance may contribute to loss of anchorage, which can be defined as unwanted movement of the anchor teeth and usually occurs when the posterior teeth move forward relative to the anterior teeth. Anchorage can be classified as: Type A or absolute anchorage, i.e. no movement of the anchor teeth occurs; Type B anchorage, i.e. movement of the anterior and posterior units toward each other; Type C anchorage, total loss of anchorage, i.e. the anchor teeth are free to move, usually anteriorly.[1] Intra-oral temporary anchorage devices (TADs) were developed to provide Type A anchorage, because this form of anchorage is difficult to accomplish with conventional biomechanics. Different types of TADs are available with the proponents of each type claiming that their device is superior to other systems. The aim of this review is twofold, firstly, to give an overview of the general and local risk factors when using TADs and the prerequisites for the placement of TADs and, secondly, to illustrate the orthodontic indications of various TADs.

Material and methods

The PubMed database was searched for original articles on 'orthodontics and miniscrews/mini-implants/miniplates/temporary anchorage devices/titanium screws/skeletal anchorage', 'miniscrews/mini-implants/miniplates and risk factors/biomechanics/placement procedure'. Only articles published between 2001 and December 2007 were used. The search retrieved 224 articles. After reading the titles

Yi-Jane Chen
Hao-Hueng Chang
Chi-Yin Huang
Hsin-Chia Hung
Eddie Hsiang-Hua Lai
Chung-Chen Jane Yao

A retrospective analysis of the failure rate of three different orthodontic skeletal anchorage systems

Authors' affiliations:
Yi-Jane Chen, Chi-Yin Huang, Eddie Hsiang-Hua Lai, Chung-Chen Jane Yao, Department of Orthodontics, School of Dentistry, National Taiwan University; Dental Department, National Taiwan University Hospital, Taipei, Taiwan
Hoa-Hueng Chang, Department of Oral and Maxillofacial Surgery, School of Dentistry, National Taiwan University; Dental Department, National Taiwan University Hospital, Taipei, Taiwan
Hsin-Chia Hung, Meiho Institute of Technology, Graduate Institute of Health Care and Department of Food Science and Nutrition, PingDong, Taiwan

Correspondence to:
Dr Chung-Chen Yao
1 Chang Te Street
Taipei
Taiwan 100
Tel.: +886 2 2312 3456 ext 768
Fax: +886 2 2383 1346
e-mail: janeyao@ntu.edu.tw

Date:
Accepted 9 November 2006

To cite this article:
Chen Y-J, Chang H-H, Huang C-Y, Hung H-C, Lai EH-H, Yao C-CJ. A retrospective analysis of the failure rate of three different orthodontic skeletal anchorage systems.
Clin. Oral Impl. Res. **18**, 2007; 768–775
doi: 10.1111/j.1600-0501.2007.01405.x

Key words: failure rate, mini-implants, miniscrews, orthodontic anchorage

Abstract

Objectives: The aim of this retrospective study was to assess systematically the case distribution among three types of mini-implants and to evaluate the clinical factors that influence the failure rates of mini-implants used as an orthodontic anchorage.

Material and methods: Data for 359 mini-implants (miniplates, miniscrews, and microscrews) in 129 patients were collected. The factors related to mini-implant failure were evaluated using univariate analysis and multivariate stepwise logistic regression analysis.

Results: Among these three different types of skeletal anchorage, there was a significant difference between the failure rates of these mini-implants, with the miniscrews and microscrews showing much higher failure rates. There were no significant differences in failure rates among the mini-implants for the following variables: gender, type of malocclusion, local or full-arch treatment, whether on the buccal or lingual side, length of the screw, loading pattern, or the duration of the healing phase. Greater risks for failure were found in younger patients, when an implant was placed for retraction/protraction, when it was placed on the mandibular arch, when it was placed anterior to the second premolars, or when using the miniscrew/microscrew systems. After adjusting for potential confounding effects, only three factors (type of mini-implant, placement on the mandibular arch, and age) were found to be statistically significant in predicting mini-implant failures ($P<0.05$) with an R^2 value of 85.2%.

Conclusions: Mini-implants placed in younger patients or placed on the mandibular arch are at a greater risk of failing. The miniplate system has greater stability compared with miniscrews or microscrews. However, it requires flap surgery for insertion and removal, which usually causes swelling and discomfort. Therefore, selection of the proper type of skeletal anchorage should be based on the specific treatment needs of each individual patient.

Anchorage is a critical issue that orthodontists deal with in daily practice and is essential for successful orthodontic treatment. However, limitations exist in toothborne anchorage because of the mobility of the anchoring teeth. Even though extraoral auxiliaries can be used to enhance anchorage, patient compliance in wearing such appliances becomes crucial. Many attempts have been made to identify stronger and immobile anchorage systems (Gainsforth & Higley 1945; Creekmore & Eklund 1983). Dental implants have successfully been used for protracting molars (Roberts et al. 1989). Thereafter, mini-implants tailored for orthodontic use were

This article has been peer reviewed.

Molar Intrusion in Open-bite Adults Using Zygomatic Miniplates

By Eiman S. Marzouk, PhD; Essam Mohamed Abdallah, PhD; Walid A. El-Kenany, PhD

Abstract: *The aim of this study is to evaluate the skeletal, dental and soft tissue changes that arise after intrusion of the maxillary molars using zygomatic miniplates in adult skeletal anterior open bite patients. In addition to measuring the amount and rate of molar intrusion; with special emphasis on changes in the axial inclination of the intruded molars. The study group was composed of 13 anterior open bite patients (mean age 18 years, 8 months ± 2 years, 2 months) with posterior dentoalveolar excess. Mini-plates were placed in the zygomatic buttress bilaterally. The upper arch was segmentally leveled and a double Trans-Palatal Arch (TPA) was bonded. Closed NiTi coil spring was placed bilaterally between the hook of the mini-plate just mesial and distal to the first molar buccal tube applying intrusive force of 450 g per side. Lateral and posteroanterior cephalograms were taken before intrusion (T1: post upper segmental leveling) and after intrusion (T2). Comparison between means before and after the intrusion was done using Wilcoxon Signed Ranks test (WSRT). Mandibular autorotation followed the molar intrusion, SNB and SN-Pog angles significantly increased while the ANB, MP-SN angle and N-S-Gn angle significantly decreased. The mean amount of accomplished molar intrusion was 3.1mm ± 0.74mm, with a rate of 0.36mm per month ± 0.08mm per month and a bite closure of 6.55mm ±1.83mm. There was no significant buccal tip in the right and left molars upon intrusion. Conclusion: Miniplates zygomatic anchorage can be used effectively for skeletal open bite correction through posterior dento-alveolar intrusion. Intrusion of the posterior teeth with skeletal anchorage induced counterclockwise rotation of the mandible and, as a consequence, corrected the anteroposterior intermaxillary relationship with a dramatic improvement in the facial soft tissue convexity.*

Keywords*: Zygomatic anchorage;Open bite treatment;Miniplates;Molar intrusion..*

Introduction:

Most orthodontists consider open bite, especially in adults, to be a significant treatment challenge. This malocclusion causes esthetic problems to the patient, impairs mastication and hinders speech.

Treatment of open bite varies depending on the underlying cause. The dental open bite malocclusion is generally found in the anterior region within the area of the cuspids and incisors and is associated with normal craniofacial pattern, proclined anteriors and reduced incisor dentolaveolar height mainly caused by various habits such as; digit sucking, forward tongue posture, as well as tongue thrust (1-3). Habit breaking appliances with cribs (4) and/or extrusion of the anterior teeth (5-10) are the common treatment modalities for these patients.

However, the majority of patients with anterior open bite and hyperdivergent skeletal pattern show excessive vertical growth of the dentoalveolar complex particularly in the molar region. These patients will be best served by applying intrusive forces to the posterior dentoalveolar segments. This can be achieved by relative intrusion of the posterior teeth either by interfering with or reducing the potential of molar eruption during the growth period (passive intrusion) using; vertical-pull chincups (11), high pull headgear (12), functional appliances (13,14), posterior bite-blocks (15,16) and repelling magnets (17-19). On the other hand, in adult patients attempts are made to physically intrude the molars into their bony support (active intrusion) (20-27).

Intrusion of posterior teeth results in counterclockwise rotation of the mandible and a concomitant reduction in the anterior facial height. However, classical treatment mechanics (11-19) are limited in actively intruding posterior teeth leaving surgical impaction of the maxillary posterior segment as the most effective treatment option in cases of skeletal anterior open bite in adult patients with posterior dento-alveolar excess (28). The complexity, the risks of general anesthesia and the cost factor of surgical treatment have initiated a search for other less invasive clinical procedures.

Accordingly, an alternative method arose to obtain vertical control by selective posterior intrusion, lacking unwanted anterior reaction forces and without dependence upon patient compliance or major surgical procedure or both. Several research workers (20, 22-27) introduced the zygomatic anchorage provided by the zygomatic buttress area as a valuable anchorage site to get effective intrusion of the maxillary posterior segment.

The aim of this clinical study is to evaluate the sole effect of intrusion of the maxillary molars in open bite adult patients with dento-alveolar posterior excess; on the skeletal, dental and soft tissues; in addition to measuring the amount and rate of molar intrusion; and evaluating the change in the axial inclination of the intruded molars.

Methods

The sample size was estimated based on a paired t test. The standard deviation was set at 1.4mm (25) and the mean difference at 2mm. Using a computer software (29), the estimated sample size was 6 at alpha = 0.05 and power of 80%.

Thirteen patients with skeletal anterior open bite were enrolled in this study, they have refused orthognathic surgery and elected this less-invasive, miniplate-assisted orthodontic treatment. Selection criteria for the study were:

1. Angle Class I or Class II Patients with anterior open bite, as defined by cephalometric overbite measurement, with at least (-3mm) and a maximum of (-8mm) with age range 16-25 years.

Evaluation of long-term stability of skeletal anterior open bite correction in adults treated with maxillary posterior segment intrusion using zygomatic miniplates

Eiman S. Marzouk and Hassan E. Kassem
Alexandria, Egypt

Introduction: This study evaluated the long-term stability of maxillary molar intrusion and anterior open-bite correction in adults treated by maxillary posterior teeth intrusion with zygomatic miniplates. **Methods:** The sample included 26 skeletal anterior open-bite patients, who had maxillary posterior segment intrusion with zygomatic miniplates. Lateral cephalograms were taken at pretreatment, posttreatment, 1 year posttreatment, and 4 years posttreatment. **Results:** The mean maxillary molar intrusion was 3.04 mm ($P \leq 0.01$), and the mean bite closure was 6.93 mm ($P \leq 0.01$). The intruded maxillary molars relapsed by 10.20% in the first year after treatment and by 13.37% by 4 years after treatment. Overbite relapsed by 8.19% and 11.18% after 1 year and 4 years posttreatment, respectively. The first year after treatment accounted for 76.29% and 73.2% of the total relapses of molar intrusion and overbite, respectively. The 4-year posttreatment relapse amounts of maxillary molar intrusion and overbite were positively correlated with the amount of pretreatment maxillary molar height and the initial open-bite severity, respectively, but negatively correlated with the amounts of maxillary molar intrusion and open-bite correction gained by treatment. **Conclusions:** Molar intrusion with zygomatic miniplates appears to be stable 4 years after treatment. (Am J Orthod Dentofacial Orthop 2016;150:78-88)

Anterior open bite has been considered a challenging malocclusion in treatment, especially in adults, and in retention, owing to its likelihood to relapse.[1-3] The deformity is caused by combined influences from skeletal, dental, respiratory, neurologic, and habitual factors.[1,3-6]

Skeletal anterior open bite is characterized by a steep mandibular plane, an obtuse gonial angle, and increased height of the lower third of the face.[7,8] Generally, patients with an anterior open bite and a hyperdivergent skeletal pattern have excessive posterior vertical growth of the dentoalveolar complex in the maxilla, the mandible, or both.

Lecturer, Faculty of Dentistry, Department of Orthodontics, Alexandria University, Alexandria, Egypt.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
Address correspondence to: Eiman S. Marzouk, 75 Ahmed Kamha St, Camp Caesar, Alexandria, Egypt; e-mail, eiman.marzouk@yahoo.com.
Submitted, June 2015; revised and accepted, December 2015.
0889-5406/$36.00

http://dx.doi.org/10.1016/j.ajodo.2015.12.014

Conventionally, treatment options for skeletal open bite in adults include the use of elastics combined with the multiloop edgewise archwire technique[9] or nickel-titanium archwires.[10] However, these mechanics cannot reduce the increased lower facial height of skeletal open bite in adults, since the open bite has been mainly masked by the extrusion of anterior teeth rather than by molar intrusion. Moreover, the extrusion of maxillary anterior teeth to close large open bites might compromise esthetic goals by causing excessive incisal and gingival display.[11]

As a result, treatment of severe skeletal anterior open bite in adults consists chiefly of orthognathic surgery to reposition the maxilla, the mandible, or both.[2,12-14] Stability of the open-bite correction was noted in approximately 75% to 85% of the patients treated with various surgical procedures.[12,14-16] In addition, the long-term stability of surgical therapies for anterior open-bite correction was investigated in a meta-analysis and indicated 82% stability of the various surgical treatments, measured by positive overbite at 12 or more months after treatment.[17] Despite the relative stability of the surgically corrected anterior open bite,

Review Article

Temporary anchorage devices – Mini-implants

Kamlesh Singh, Deepak Kumar[1], Raj Kumar Jaiswal, Amol Bansal

Department of Orthodontics and Dentofacial Orthopedics, [1]Oral and Maxillofacial Surgery, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow, Uttar Pradesh, India

Address for correspondence:
Dr. Kamlesh Singh,
C-328, Indra Nagar, Aravali Marg, Lucknow, Uttar Pradesh, India.
E-mail: dr_deepak_singh@hotmail.com

DOI: 10.4103/0975-5950.69160
www.njms.in

ABSTRACT

Orthodontists are accustomed to using teeth and auxiliary appliances, both intraoral and extraoral, to control anchorage. These methods are limited in that it is often difficult to achieve results commensurate with our idealistic goals. Recently, a number of case reports have appeared in the orthodontic literature documenting the possibility of overcoming anchorage limitations via the use of temporary anchorage devices—biocompatible devices fixed to bone for the purpose of moving teeth, with the devices being subsequently removed after treatment. Although skeletal anchorage is here to stay in orthodontics, there are still many unanswered questions. This article describes the development of skeletal anchorage and provides an overview of the use of implants for orthodontic anchorage.

Key words: Anchorage, mini-implant, TAD

Orthodontic Anchorage

Although the principle of orthodontic anchorage has been implicitly understood since the 17th century,[1] it does not appear to have been clearly articulated until 1923 when Louis Ottofy[2] defined it as "the base against which orthodontic force or reaction of orthodontic force is applied." Most recently, Daskalogiannakis[3] defined anchorage as "resistance to unwanted tooth movement." It can also be defined as the amount of allowed movement of the reactive unit. Using this definition requires clarification of the reactive unit (tooth/teeth acting as anchorage during movement of the active unit) as well as the active unit (tooth/teeth undergoing movement).

Ottofy[2] also summarized the anchorage categories previously outlined by E.H. Angle and others as simple, stationary, reciprocal, intraoral, intermaxillary, or extraoral. Since that time, several noted authors have modified or developed their own classification. For example, Moyers[4] expanded Ottofy's classification system by clearly outlining the different subcategories of extraoral anchorage, as well as breaking down simple anchorage into single, compound, and reinforced subcategories. Later, others developed their own classification terminology. Gianelly and Goldman[5] suggested the terms *maximum*, *moderate*, and *minimum* to indicate the extent to which the teeth of the active and reactive units should move when a force is applied. Marcotte[6] and Burstone[7] classified anchorage into three categories—A, B, and C—depending on how much of the anchorage unit contributes to space closure. Tweed[8] went further to define anchorage preparation, or the uprighting, and even the distal tipping of posterior teeth to utilize the mechanical advantage of the tent peg before retracting anterior teeth.

Considering the above classification systems, it becomes apparent that a lack of consensus exists on the terminology for describing anchorage. Moreover, these systems are outdated and do not currently provide clear guidelines with which the orthodontist can clearly and concisely communicate. For example, these classification systems only account for anteroposterior dental relationships and do not really account for vertical or transverse relationships. They also only account for the anteroposterior extent of the dental bases and do not account for distalizing the dentition to create a Class I dental relationship without the need for extractions or surgery.

Moreover, they only account for groups of teeth; they do not account for individual teeth, nor do they account for the entire occlusal plane. The reason for the latter is most likely because at the time these classification

Open-bite treatment with vertical control and tongue reeducation

Justin Garrett,[a] Eustaquio Araujo,[b] and Christopher Baker[c]
Charleston, SC, St Louis, Mo, and Cary, NC

An open-bite malocclusion with a tongue-thrust habit is a challenging type of malocclusion to correct. A 12-year-old girl came for orthodontic treatment with a severe anterior open bite, extruded posterior segments, a tongue-thrust habit, and lip incompetency. Her parents refused surgical treatment, so a nonextraction treatment plan was developed that used palatal temporary skeletal anchorage devices for vertical control and mandibular tongue spurs to reeducate the tongue. Interproximal reduction was also used to address the moderate to severe mandibular crowding. An abnormal Class I occlusion was achieved with proper overbite and overjet, along with a pleasing smile and gingival display. (Am J Orthod Dentofacial Orthop 2016;149:269-76)

The etiology of open bites remains controversial and in some cases unanswered. However, there is agreement about the difficulties of treating patients with the dental and skeletal characteristics associated with this vertical discrepancy. Dental open bites are a specific type of malocclusion caused primarily by local or environmental factors. Often local etiology is correlated with habits or trauma. When a skeletal component is present, the etiology menu incorporates heredity and other health-related issues including allergies, hypertrophy of the lymphatic tissues, muscular hypotonicity, syndromes, and neurologic problems as possible contributors to the malocclusion. The literature cites causes and effects of inherited skeletal patterns (eg, vertical maxillary excess) caused by a digit-sucking habit, a tongue-thrust habit, supererupted posterior teeth, and an airway obstruction among the most prevalent causes of an open bite.[1,2]

Many treatment modalities have been tested, some with varying degrees of success. Often, a treatment option is highly correlated with the severity of the malocclusion. Some less complex open bites may resolve by themselves during the transition from the mixed to the permanent dentition.[3] Others require complex modalities, including extraction of permanent teeth, intrusion of the posterior dentition, extrusion of the anterior dentition, or orthognathic surgery (predominately maxillary impaction).[4-6]

Most recently, the use of temporary anchorage devices (TADs) has supported treatment options without surgery or extractions. At present, many complex types of malocclusions can be treated orthodontically with TADs. TADs can provide skeletal anchorage to move teeth in all directions, giving clinicians minimally invasive treatment modalities that were not possible previously.[7,8] They can also aid in the treatment of open bites by providing adequate anchorage for the intrusion of posterior teeth with a transpalatal arch (TPA). The TPA is attached to palatally placed TADs with power chains or closed-coil springs.[9,10] Intrusion of the posterior maxillary dentition allows autorotation of the mandible and therefore closure of the anterior open bite. Depending on a comprehensive diagnostic protocol including the severity of the malocclusion, this technique allows for a treatment option that eliminates the need for surgical impaction of the maxilla.[11]

DIAGNOSIS AND ETIOLOGY

A 12-year-old female came to the orthodontic clinic with chief complaints of a severe open bite and a history of speech problems. She was in myofunctional therapy at that time. The clinical examination showed an infantile swallowing pattern, anterior resting tongue posture, and a history of mouth breathing. The radiographic and clinical examinations of the temporomandibular joint showed no symptoms. She had normal joint function and joint structure (Figs 1-3).

[a]Private practice, Charleston, SC.
[b]Clinic director, Graduate Orthodontics, Center for Advanced Dental Education, Saint Louis University, St Louis, Mo.
[c]Private practice, Cary, NC.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
Address correspondence to: Christopher Baker, 2625 Green Level West Rd, Cary, NC 27519; e-mail, chrlbake@gmail.com.
Submitted, October 2014; revised and accepted, March 2015.
0889-5406/$36.00

http://dx.doi.org/10.1016/j.ajodo.2015.03.035

Junji Sugawara, DDS, PhD
Associate Professor
Division of Orthodontics and Dentofacial Orthopedics

Un Bong Baik, DDS
Graduate Student
Division of Orthodontics and Dentofacial Orthopedics

Mikako Umemori, DDS, PhD
Ichiro Takahashi, DDS, PhD
Research Associate
Division of Orthodontics and Dentofacial Orthopedics

Hiroshi Nagasaka, DDS, PhD
Research Associate
Division of Maxillofacial Surgery

Hiroshi Kawamura, DDS, PhD
Associate Professor
Division of Maxillofacial Surgery

Hideo Mitani, DDS, MS, PhD
Professor and Chairman
Division of Orthodontics and Dentofacial Orthopedics

Graduate School of Dentistry
Tohoku University
Sendai, Japan

Reprint requests:
Dr Junji Sugawara
Division of Orthodontics and Dentofacial Orthopedics
Tohoku University
Graduate School of Dentistry
4-1, Seiryo-machi, Aoba-ku
Sendai, 980-8575, Japan
Fax: +81-22-717-8373
E-mail:
sugahara@mail.cc.tohoku.ac.jp

Treatment and posttreatment dentoalveolar changes following intrusion of mandibular molars with application of a skeletal anchorage system (SAS) for open bite correction

The skeletal anchorage system (SAS) consists of titanium anchor plates and monocortical screws that are temporarily implanted in either the maxilla or the mandible as absolute orthodontic anchorage. With SAS, anterior open bite can be improved by the counterclockwise rotation of the mandible, accompanied by the intrusion of molars. The present study was designed to evaluate treatment and posttreatment dentoalveolar changes following the intrusion of mandibular molars. Nine adult open bite patients (7 women and 2 men) successfully treated with SAS were included in the following study. The amount of intrusion, relapse, and dentoalveolar changes were measured on cephalometric radiographs, panoramic radiographs, and dental casts. The results of this study were as follows: (1) the average amount of intrusion of the mandibular first and second molars was 1.7 mm and 2.8 mm, respectively; (2) the average relapse rates were 27.2% at the first molars and 30.3% at the second molars; (3) there were no significant changes in crestal bone heights, clinical crown length, or root length; and (4) counterclockwise rotation of the mandible and decrease of anterior facial height were observed during treatment. Thus, it was concluded that SAS would be a valid modality to intrude mandibular molars for correction of open bite. (Int J Adult Orthod Orthognath Surg 2002;17:243–253)

Skeletal open bite has been recognized as the most difficult malocclusion to correct in clinical orthodontics, because of the high frequency of relapse. Generally, open bite patients are characterized by vertical dentoalveolar excess in the maxilla and/or the mandible. Traditionally, open bite has been corrected by the extrusion of anterior teeth,[1] by surgical maxillary impaction in adult patients,[2,3] or by the inhibition of molar eruption in growing patients.[4–6] Dellinger[7] and Barbre and Sinclair[8] introduced an active vertical corrector (AVC) that used the repellent force of magnets and reported some intrusive effects of molars in growing open bite patients. Kim[9] and Chang and Moon[10] introduced a multiloop edgewise archwire (MEAW) technique for open bite correction, which worked by uprighting the molars and extruding the anterior teeth subsequent to the alteration of the occlusal plane. However, with these kinds of orthodontic mechanics, it is extremely difficult to reduce the excessive lower facial height of open bite patients, because the open bite has been mostly camouflaged by the extrusion of anterior teeth, not by the intrusion of molars.

Recently, we developed the skeletal anchorage system (SAS), which utilizes titanium miniplates and monocortical bone screws as absolute orthodontic anchorages, mostly for correction of skeletal open bite and Class III malocclusion.[11–13] SAS consists

ORIGINAL ARTICLE

Closing anterior open bites by intruding molars with titanium miniplate anchorage

Keith H. Sherwood, DDS,[a] James G. Burch, DDS, MS,[b] and William J. Thompson, DDS, MS[b]
Fort Lauderdale, Fla

The intent of this study was threefold: (1) to validate true intrusion of molars in adults, (2) to test the stability of miniplates as anchorage for intruding posterior teeth in the maxilla, and (3) to record the skeletal and dental changes of open-bite closure. Four adult patients who had anterior open-bite malocclusions were selected to undergo posterior intrusion with miniplate anchorage to close the open bite; all had true intrusion of the maxillary molars. Mean molar intrusion was 1.99 mm (range, 1.45-3.32 mm). No movement of miniplates occurred at any time during their use or before intentional clinical removal. Open-bite closure was achieved for all 4 patients. Mean closure of incisors was 3.62 mm (range, 3.0-4.5 mm) as the mandibular plane closed 2.62° (range, 1.5°-4.5°), and the occlusal plane decreased 2.25° (range, 1.0°-3.5°). Anterior facial heights decreased as the mandible closed and B-point rotated anteriorly and upward. (Am J Orthod Dentofacial Orthop 2002;122:593-600)

Many techniques, case reports, and limited studies have been reported for the orthodontic treatment of malocclusions characterized by anterior open bites. Extrusion or eruption of anterior teeth is a common method of bite closure. However, Harris and Butler[1] described a series of adolescent patients with anterior open bites as having significantly shorter roots and less facial bone support of the anterior teeth. Graber[2] pointed out that adults might be more prone to root resorption with orthodontic manipulation. Incisor extrusion to close the bite in adults could be destructive in this compromised area of the dentition. Reitan and Rygh[3] reported that extruded teeth are less stable than intruded teeth. Finally, the extrusion of maxillary anterior teeth might compromise esthetics. For all of these reasons, closing anterior open bites by dental extrusion is contraindicated in certain patients.

Other treatment methods for closing open bites apply intrusive forces to posterior teeth. Posterior bite blocks have been recommended to correct anterior open bites.[4,5] Bite blocks augmented with magnets[6-8] or springs[9] have also been used. Multi-loop edgewise archwire techniques have been applied after second or third molar extraction.[10,11] Reportedly, the occlusal plane is changed by extruding the anterior teeth while uprighting and intruding the posterior teeth to close the anterior open bite. High-pull headgear[5] and headgear with a posterior bite block[5,12] have been advocated for use in the mixed dentition to slow or prevent vertical development in the maxillary molar region of children as they continue to grow. This "relative intrusion" retards posterior vertical dentoalveolar development and decreases the potential for an anterior open bite to form.

Few 10-year posttreatment studies involving large numbers of patients with diagnostically comparable open bites have been published. Lopez-Gavito et al[13] reported the results of a study of 41 patients who had been treated for comparable open-bite malocclusions. Records gathered at least 9.6 years after orthodontic treatment were studied. On evaluating the sample, the authors noted a significant increase in the distance from the mandibular plane to the mandibular incisor during treatment, suggesting the use of incisor extrusion to assist in closing the open bite. Furthermore, at all time periods, the mandibular incisor's vertical position was depressed in the relapsed subgroup compared with the stable subgroup. More than 35% of the treated open-bite patients demonstrated a postretention open bite of 3 mm or more. No statistics were given for smaller open bites. This study and others[14] show that predictability of a stable outcome in the long term is low. Furthermore, these findings of compromise were in a group of patients whose pretreatment median age was 12.5 years. One might expect even more relapse and greater problems in treating open-bite malocclusions in adults.[12,15,16]

From the Department of Orthodontics, Nova Southeastern University College of Dental Medicine, Fort Lauderdale, Fla.
[a]Assistant professor.
[b]Professor.
Reprint requests to: Keith H. Sherwood, DDS, Nova Southeastern University College of Dental Medicine, Department of Orthodontics, 3200 S University Dr, Fort Lauderdale, FL 33328-2018; e-mail, sherwood@nova.edu.
Submitted, December 2001; revised and accepted, June 2002.

0889-5406/2002/$35.00 + 0 **8/1/128641**
doi:10.1067/mod.2002.128641

Original Article

Noncompliance Open-Bite Treatment with Zygomatic Anchorage

Nejat Erverdi[a]; Serdar Usumez[b]; Alev Solak[c]; Tamer Koldas[d]

ABSTRACT

Objective: To evaluate the dentoalveolar and skeletal effects of the new-generation open-bite appliance.

Subjects and Methods: The study group was composed of 11 subjects with a mean age of 19.5 years who underwent intrusion of the posterior dentoalveolar segment using an open-bite appliance supported by bilateral zygomatic implants. The study was carried out on lateral cephalograms of the subjects taken before treatment and after intrusion. The mean intrusion time was 9.6 months.

Results: The mean intrusion measured as the distance of the U6 to the palatal plane was 3.6 ± 1.4 mm ($P < .001$). This resulted in an average of 3.0° ± 1.5° of closure of the Go-Gn-SN angle ($P < .001$). The gain in the overbite was 5.1 ± 2.0 mm ($P < .001$), and the overjet was reduced by 1.4 ± 1.5 mm ($P < .01$). The change in the occlusal plane angle was an average of 2.4° ± 1.4° counterclockwise rotation ($P < .001$). The lower facial height was also decreased significantly by 2.9 ± 1.3 mm ($P < .001$). No significant changes were observed in the SNA angle and incisor positions ($P > .05$), except for the interincisal angle, which was increased by 3.5° ($P < .05$).

Conclusion: Zygomatic anchorage can be used effectively for open-bite correction through posterior dentoalveolar intrusion.

KEY WORDS: Open bite; Zygomatic anchorage; Posterior dentoalveolar intrusion

INTRODUCTION

There is no question that one of the most difficult malocclusions to treat and maintain in orthodontics is the anterior open bite. Morphologic traits of these cases usually include increased vertical dimensions due to the vertical overgrowth of the maxillary posterior dentoalveolar structures, which should be reduced to correct the skeletal open bite properly.[1–3] This is generally managed with the surgical impaction of the maxilla, which allows the reduction of the anterior facial height.[4] However, orthognathic surgery is complex, brings about risk and cost issues, and is not always easily accepted by the patients and/or the parents. Therefore, clinicians have been working on alternative clinical procedures to correct this skeletal discrepancy.

Early efforts for open-bite correction included the use of bite blocks in the late 1980s,[5–9] fixed appliance and vertical elastic combinations in 1990s,[10–12] and new face mask designs at the beginning of this millennium.[13] All of these proved to be effective in passive intrusion of the maxillary posterior segment.[5–7,9] However, the actual correction was achieved primarily through the extrusion of incisors or by preventing passive eruption of posterior teeth. These untoward effects led clinicians to use the osseointegrated implants or surgical miniplates and screws, which recently gained great interest as anchorage units for orthodontic purposes.[14–21] These devices have been used for the intrusion of lower[22,23] and upper[24–29] molars.

One interesting application is the use of titanium miniplates placed at the zygomatic buttress region for anchorage purposes.[25–29] Despite the fact that a few anecdotal case presentations and technical reports demonstrated successful results,[24–30] the effects of this treatment protocol on a larger sample of subjects are missing. Therefore, the aim of this study was to evaluate the dentoalveolar and skeletal effects of the new-

[a] Professor, Department of Orthodontics, Faculty of Dentistry, Marmara University, Istanbul, Turkey.

[b] Associate Professor, Department of Orthodontics, Faculty of Dentistry, Marmara University, Istanbul, Turkey.

[c] Orthodontic Specialist, Istanbul, Turkey.

[d] Professor, Capa Faculty of Medicine, Department of Plastic and Reconstructive Surgery, Istanbul University, Istanbul, Turkey.

Corresponding author: Dr Serdar Usumez, Department of Orthodontics, Faculty of Dentistry, Marmara University, Guzelbahce Buyukciftlik Sok. No. 6, Nisantasi, Istanbul, Turkey 34346. (e-mail: susumez@hotmail.com)

Accepted: January 2007. Submitted: October 2006.

 DOI: 10.2319/101206-422.1

European Journal of Orthodontics 35 (2013) 93–102
doi:10.1093/ejo/cjr081
Advance Access publication 9 August 2011

Effects of maxillary molar intrusion with zygomatic anchorage on the stomatognathic system in anterior open bite patients

Seden Akan*, Ilken Kocadereli**, Alper Aktas*** and Ferda Taşar***
*Department of Orthodontics, Baskent University Istanbul Hospital and Departments of **Orthodontics and, ***Oral and Maxillofacial Surgery, Faculty of Dentistry, Hacettepe University, Ankara, Turkey

Correspondence to: Seden Akan, Baskent Üniversitesi Istanbul Uygulama ve Arastirma Hastanesi, Ortodonti Anabilim Dali, Mahir Iz Cad. No: 43, 34662 Altunizade, Istanbul, Turkey. E-mail: sedenakandt@hotmail.com

SUMMARY The aim of this study was to evaluate the effects of intrusion of the maxillary posterior teeth with zygomatic anchorage on the dentofacial system, on electromyographic (EMG) activity of the masticatory muscles, and on vibration of the temporomandibular joint. The study sample consisted of 19 subjects (13 females, 6 males) with a mean age of 17.7 years. Lateral cephalometric and posteroanterior (PA) radiographs, EMG, and electrovibratographic (EVG) records were obtained before (T0) and after (T1) intrusion. Paired *t*- and Wilcoxon signed ranks tests were used for statistical evaluation. Maxillary molar intrusion of 3.37 ± 1.21 mm was obtained with a force of 400 g in an average period of 6.84 ± 1.64 months. At T1, all measurements showed that facial growth direction, ANB angle, convexity, and overjet were decreased ($P < 0.05$). SNB angle, facial depth, and overbite were significantly increased ($P < 0.05$). Upper lip-E plane distance was increased ($P < 0.05$). Evaluation of the PA radiographs showed that the right and left molar reference angles were unchanged. EMG and EVG analysis showed that the stomatognathic system at T0 was maintained at T1. Intrusion of the maxillary posterior teeth with zygomatic anchorage is an effective treatment alternative for anterior open bite correction.

Introduction

An open bite is one of the main symptoms of an overall dentofacial deformity. Most subjects with an anterior open bite (AOB) are characterized by overeruption of the maxillary molars (Schudy, 1965). When orthodontic or surgical intrusion of the overerupted maxillary teeth is performed, the mandible rotates, resulting in open bite closure (Bell, 1980).

Intrusion of the molar teeth with traditional orthodontic mechanics is difficult. The multiloop edgewise archwire has been recommended for open bite closure in non-growing patients, but with this approach, the correction is achieved mainly through extrusion of the incisors without skeletal change (Kim, 1987; Kim *et al.*, 2000).

Until recently, there was no orthodontic approach for predictable intrusion of the maxillary posterior teeth in non-growing patients. Skeletal anchorage has been suggested for the orthodontic movement of teeth (Ödman *et al.*, 1988; Costa *et al.*, 1998; Kokich, 2000).

Due to increased interest in the functional aspects of the stomatognathic system, diagnosis of malocclusion and evaluation of the results of orthodontic treatment should not be restricted only to clinical and cephalometric evaluation. Facial musculature is directly and intimately related to the development of malocclusions; its correct functioning is fundamental in obtaining equilibrium of the stomatognathic system and treatment planning.

Electromyographic (EMG) analysis of the masticatory muscles, which has good reproducibility, provides useful data regarding the functional impact of morphological discrepancies and permits functional evaluation of treatment of occlusal relationships (Ferrario *et al.*, 1999; Alarcón *et al.*, 2000). Currently, many areas of health care, such as medicine, physiotherapy, and speech therapy include superficial EMG examinations to assist in diagnoses, establishing a more accurate prognosis and accompanying muscular performance during various types of treatment. Despite its usefulness, no studies have evaluated the behaviour of these muscles in patients with an AOB treated with intrusion of the maxillary posterior teeth with zygomatic anchorage.

With developing technology, orthodontists must evaluate more than subjective findings (e.g. palpation and auscultation) when evaluating the temporomandibular joint (TMJ). There is a need to objectively assess the patient's joint health and document both pre-treatment conditions and the response to treatment.

Electrovibratography (EVG) is a method to objectively evaluate the TMJs and identify vibration patterns that help to distinguish primary TMJ dysfunction from other painful conditions. This method is the electronic recording of TMJ sounds that has a high specificity. TMJ sounds are frequently found among temporomandibular joint dysfunction (TMD) patients (Ishigaki *et al.*, 1992; Mazzetto *et al.*, 2008). It has been reported that certain groups of TMD patients show a higher incidence of TMJ sounds (Agerberg and Carlsson, 1975; Mazzetto *et al.*, 2008), and it is important to demonstrate the diagnostic specificity and sensitivity of these sounds (Elfving *et al.*, 2002).

Oral Maxillofac Surg (2015) 19:71–77
DOI 10.1007/s10006-014-0457-2

ORIGINAL ARTICLE

Maxillary molar intrusion with zygomatic anchorage in open bite treatment: lateral and oblique cephalometric evaluation

Talles Fernando Medeiros de Oliveira · Cecília Yuriko Nakao · João Roberto Gonçalves · Ary Santos-Pinto

Received: 22 March 2014 / Accepted: 16 July 2014 / Published online: 31 July 2014

Abstract
Purpose We aimed to use lateral and oblique radiographs to evaluate dental and skeletal changes arising from maxillary molar intrusion with zygomatic anchorage in open bite patients.
Methods We conducted a pilot study including nine patients (six females and three males; mean age, 18.7±5.1 years) with skeletal open bite treated with titanium miniplates for posterior dentoalveolar intrusion. Lateral and oblique (right and left, 45°) radiographs were obtained before (T1) and 6 months after intrusion (T2). A paired *t* test was used for statistical evaluation.
Results The maxillary posterior teeth were intruded 2.03± 0.87 mm ($p<0.01$) with 450×*g* of force, which resulted in counterclockwise rotation of the mandible (1.57°, $p=0.02$) and clockwise rotation of the occlusal plane (4.27±2.66°, $p=0.01$). Anterior facial height decreased by a mean of 1.79±1.51 mm ($p<0.01$). No significant change in the palatal plane or in anteroposterior molar movement was observed.
Conclusion The oblique radiograph at 45° was useful for the assessment of molar intrusion and anteroposterior displacement. The treatment of anterior open bite with skeletal anchorage provided intrusion of molars and counterclockwise rotation of the mandible, resulting in open bite closure.

Keywords Miniplates · Open bite · Orthodontic anchorage techniques · Tooth intrusion

Introduction

Anterior open bite is a malocclusion that is difficult to treat in orthodontics [1–7]. Its etiology involves skeletal, dental, and functional factors, as well as deleterious habits [1, 5]. The morphology of this malocclusion is generally characterized by increased vertical dimension, excessive eruption of posterior teeth, and increased mandibular plane angle [2, 3, 5, 8–10].

Several orthodontic treatments for open bite have been suggested, involving extrusive forces on anterior teeth or intrusive forces on posterior teeth [5]. Extrusion of anterior teeth is a common method to treat open bite; however, it is less stable than dental intrusion [11], impairs esthetic treatment, and is contraindicated in patients with skeletal open bite [1, 4, 12]. Treatments with bite block, high-pull headgear, and functional appliances have been used to promote dentoalveolar intrusion and control of vertical growth [5]. These devices have been effective in the treatment of open bite; however, malocclusion correction was primarily achieved by extrusion of incisors and prevention of the eruption of posterior teeth [2], which is not effective in adult patients [13]. Intrusion of molars with conventional orthodontics is difficult [8, 10].

Orthognathic surgery and skeletal anchorage have been used to treat open bite in adult patients [1–4, 8, 10, 12]. With skeletal anchorage, the correction of anterior open bite is achieved by the intrusion of upper molars [2, 3, 6, 12]. Kuroda et al. [4] demonstrated the advantages of this treatment compared with orthognathic surgery.

T. F. M. de Oliveira (✉) · J. R. Gonçalves · A. Santos-Pinto
Department of Orthodontics, Araraquara School of Dentistry, UNESP—University Estadual Paulista, Rua Humaitá, 1680, Araraquara, São Paulo, Brazil
e-mail: talles_fernando@yahoo.com.br

C. Y. Nakao
Department of Orthodontics, Catanduva School of Dentistry, IMES-FAFICA, Catanduva, São Paulo, Brazil

Open-Bite Treatment Using Maxillary and Mandibular Miniplates

JAE HYUN PARK, DMD, MSD, MS, PHD
KIYOSHI TAI, DDS, PHD
MASATO TAKAGI, DDS, PHD

The development of temporary anchorage devices (TADs) has offered new options for treating orthodontic problems such as anterior open bite by means of molar intrusion, Class II malocclusion by maxillary molar distalization, Class III malocclusion by maxillary protraction or mandibular distalization, deep bite by anterior intrusion, and spacing from missing posterior teeth with mesialization.[1-7] The slightly lower reported success rate of miniscrews (about 86.5%[8]) compared to miniplates (91-96%[5,9]) is due to the tendency of miniscrews to loosen when orthodontic force is applied.[9] On the other hand, the ease of insertion and removal of miniscrews under local anesthesia gives them an advantage over miniplates, which require flap-raising surgery for insertion and removal. Still, there are certain clinical situations in which miniplates may be preferable—for example, in open-bite patients or when en masse distalization is required—because they allow efficient tooth movement without the need for removal and reinstallation.[4,5]

Conventional therapies for the correction of skeletal open bite[10,11] have included high-pull headgear,[12] fixed appliances such as the Multiloop Edgewise Arch Wire (MEAW),[13] tongue cribs,[14] posterior bite blocks,[15] posterior magnets,[16] and vertical elastics.[17] All of these rely on patient compliance and are less effective in adult patients. More severe cases of anterior open bite have traditionally required orthognathic surgery. As an alternative, several authors have recently had success in treating open bite with skeletal anchorage from TADs.[18] This article shows how an open bite with a canted palatal plane can be treated with a combination of maxillary and mandibular miniplates.

Dr. Park

Dr. Tai

Dr. Takagi

Dr. Park is an Associate Professor and Chair, Postgraduate Orthodontic Program, Arizona School of Dentistry & Oral Health, A.T. Still University, 5835 E. Still Circle, Mesa, AZ 85206, and an Adjunct Professor, Graduate School of Dentistry, Kyung Hee University, Seoul, South Korea; e-mail: jpark@atsu.edu. Dr. Tai is a Visiting Adjunct Assistant Professor, Postgraduate Orthodontic Program, Arizona School of Dentistry & Oral Health, A.T. Still University, and an Adjunct Professor, Graduate School of Dentistry, Kyung Hee University. Drs. Tai and Takagi are in the private practice of orthodontics in Okayama, Japan.

Miniscrew implant를 이용한 상악 구치부 압하와 개방교합 치료의 효과 및 안정성

이 한 아[a]·박 영 철[b]

최근 절대적인 고정원의 등장으로 다른 부작용 없이 구치부 압하 치료를 가능하게 하였고, 비수술적으로 개방교합의 심미적인 치료를 가능하게 하였다. 그러나, 이러한 치료법의 장기적인 안정성에 대한 연구는 많이 부족한 실정이다. 이에 본 연구에서는 miniscrew implant를 이용하여 상악 구치를 압하시켜 치료한 성인 개방교합 환자 11명(남자 1명, 여자 10명)을 대상으로 치료 전후, 그리고 유지기의 골격성, 치아 치조성 변화를 측모 두부 방사선사진을 이용하여 평가하였으며 계측치의 치료 전후 변화량간의 상관관계와 치료에 의한 변화량과 재발량과의 상관관계를 규명하여 상악구치의 압하를 통해서 개방교합을 치료할 때에 안정성을 평가하였다. 그 결과로 상악 구치는 2.22 mm 압하($p < 0.001$)가 일어났고, 평균 17.4개월 유지 후 0.23 mm의 정출($p = 0.359$)이 나타났으며, 재발율은 10.36%로 나타났다. 전치부의 수직피개는 평균 5.47 mm의 증가($p < 0.01$)가 나타났고 평균 17.4개월 유지 후 0.99 mm의 감소($p < 0.05$)가 나타나서, 재발량은 18.10%로 계산되었다. 치료 전후 수치 변화량의 상관분석을 통해 상악구치 압하량과 하악 평면각 변화량이 상관관계($p < 0.05$)가 있었다. 치료 전의 개방교합량, 하악 평면각, 전하안면고경과 치료 후의 수직피개 재발량과는 상관관계가 없었다. 상악 구치 압하량과 수직피개 개선량에서 치료에 의한 변화량과 재발량이 통계적으로 유의한 상관관계를 보였고, 이를 토대로 재발량을 예측할 수 있었다. 이상의 결과를 통하여 성인 개방교합 환자에서 miniscrew implant를 이용한 상악구치부의 압하는 비수술, 심미적 접근방법으로 효율적이고 안정적인 치료방법으로 유용하게 사용할 수 있을 것으로 생각된다. (대치교정지 2008;38(1):31-40)

주요 단어: 상악 구치 압하, 전치 개방교합, Miniscrew implant, 안정성

서론

개방교합은 교정치료 시에 가장 어려움을 겪게 되는 부정교합의 하나로 인식되어 왔다. 여러 가지 치료방법을 시도하였지만 그 안정성에 대한 논란이 끊이지 않았기 때문이다. 이러한 환자들은 주로 상악 구치부의 과도한 수직 성장 양상으로 전치부에 개방교합이 발생하게 되는데, 전통적으로는 전치부 정출을 유도하거나 성인이 되었을 때 수술적으로 상악골을 상방 재위치시켜 치료가 이루어지는 것이 보편적이다.

Lopez-Gavito 등[1]의 연구에 따르면 개방교합 환자를 전치부 정출을 통해 치료하고 10년간 관찰하였을 때에 35%에서 3 mm이상의 재발이 나타났다고 하였다. 재발이 일어난 그룹에서는 하전안면고경의 비율이 상대적으로 더 길게 나타났다. 성인에서는 개방교합의 치료에도 어려움을 겪게 되고, 재발도 더욱 크게 나타나므로 안정성이 떨어진다.

Janson 등[2,3]이 시행한 영구치열기 개방교합 환자에서의 발치, 비발치 치료 시에 안정성에 관한 연구에서는 비발치 환자에서 61.9%의 안정성을 보였고, 발치 환자에서 74.2%에서 안정성을 보여 발치 환자에서의 안정성이 더 높은 것으로 나타났다. 이것은 발치 환자에서 나타나는 drawbridge 원리에 의한 것으로 전치의 정출이 적기 때문에 안정성이 더 높은

[a]전공의, 연세대학교 치과대학 교정학교실.
[b]교수, 연세대학교 치과대학 교정학교실, 구강과학연구소 연구원, 두개안면기형연구소 연구원.
*교신저자: **박영철.***
서울특별시 서대문구 신촌동 134번지 연세대학교 치과대학 교정학교실. 02-2228-3000; e-mail, ypark@yuhs.ac.
원고접수일: 2007년 8월 29일 / 원고최종수정일: 2007년 11월 29일 / 원고채택일: 2007년 12월 1일.
*본 논문은 2006년도 연세대학교 치과대학 교수연구비(2006-0013)에 의하여 연구되었음.

ONLINE ONLY

Long-term stability of anterior open-bite treatment by intrusion of maxillary posterior teeth

Man-Suk Baek, Yoon-Jeong Choi, Hyung-Seog Yu, Kee-Joon Lee, Jinny Kwak, and Young Chel Park
Seoul, Korea

Introduction: Anterior open bite results from the combined influences of skeletal, dental, functional, and habitual factors. The long-term stability of anterior open bite corrected with absolute anchorage has not been thoroughly investigated. The purpose of this study was to examine the long-term stability of anterior open-bite correction with intrusion of the maxillary posterior teeth.

Methods: Nine adults with anterior open bite were treated by intrusion of the maxillary posterior teeth. Lateral cephalographs were taken immediately before and after treatment, 1 year posttreatment, and 3 years posttreatment to evaluate the postintrusion stability of the maxillary posterior teeth.

Results: On average, the maxillary first molars were intruded by 2.39 mm ($P < 0.01$) during treatment and erupted by 0.45 mm ($P < 0.05$) at the 3-year follow-up, for a relapse rate of 22.88%. Eighty percent of the total relapse of the intruded maxillary first molars occurred during the first year of retention. Incisal overbite increased by a mean of 5.56 mm ($P < 0.001$) during treatment and decreased by a mean of 1.20 mm ($P < 0.05$) by the end of the 3-year follow-up period, for a relapse rate of 17.00%. Incisal overbite significantly relapsed during the first year of retention ($P < 0.05$) but did not exhibit significant recurrence between the 1-year and 3-year follow-ups.

Conclusions: Most relapse occurred during the first year of retention. Thus, it is reasonable to conclude that the application of an appropriate retention method during this period clearly enhances the long-term stability of the treatment.

Read the full text online at: www.ajodo.org, pages 396.e1-396.e9.

Am J Orthod Dentofacial Orthop 2010;138:396-8
0889-5406/$36.00

doi:10.1016/j.ajodo.2010.05.006

EDITOR'S COMMENT

We can expect to achieve long-term success in the closure of anterior open bites 75% of the time by treating this malocclusion with fixed appliances, with either a nonsurgical or surgical approach, depending on the overall skeletal and esthetic demands of the case. But for some patients, neither option is ideal. A nonsurgical approach often requires full-time use of elastics to close the open bite by extruding the anterior teeth. This type of tooth movement demands excellent cooperation, might not enhance facial esthetics, and could also be unstable. When considering the other choice, to many people, "surgery" is still "surgery" and might be rejected for any number of reasons. With good studies to support what can and cannot be achieved in the treatment of malocclusions characterized by anterior open bite, there is still room for a third option—treatment with miniscrew implants to intrude the maxillary posterior teeth. Several questions then come to mind. How far can the maxillary posterior teeth be safely intruded? Will this approach lead to increased stability? If immediate stability is not 100%, what can be done to prevent the return of bite opening in both the short and long terms?

In this clinical study, 9 patients treated with miniscrew implants to intrude the maxillary posterior teeth were followed for at least 3 years posttreatment. The subjects were selected according to the following criteria: (1) diagnosed with incisal open bite (incisor overbite, <-1.0 mm), (2) high SN-MP angle ($>40^\circ$), and (3) skeletal Class I or Class II discrepancy (anteroposteriorly). Two methods were used for intrusion of the maxillary molars. The first method called for placement of the miniscrew implants on the buccal and palatal sides between the roots of the maxillary second premolar and first molar, and between the roots of the maxillary first and second molars. After 1 to 2 weeks, an intrusive force was directly applied to the molars with elastomeric chains (Fig 1, *A* and *B*). The second method called for the placement of miniscrew implants on the buccal side only between the roots of the maxillary second premolar and first molar, and between the roots of

Outcomes and stability in patients with anterior open bite and long anterior face height treated with temporary anchorage devices and a maxillary intrusion splint

Nicole R. Scheffler,[a] William R. Proffit,[b] and Ceib Phillips[c]
Chapel Hill, NC

Introduction: Temporary skeletal anchorage devices now offer the possibility of closing anterior open bites and decreasing anterior face height by intruding maxillary posterior teeth, but data for treatment outcomes are lacking. This article presents outcomes and posttreatment changes for consecutive patients treated with a standardized technique. **Methods:** The sample included 33 consecutive patients who had intrusion of maxillary posterior teeth with a maxillary occlusal splint and nickel-titanium coil springs to temporary anchorage devices in the zygomatic buttress area, buccal and apical to the maxillary molars. Of this group, 30 had adequate cephalograms available for the period of treatment, 27 had cephalograms including 1-year posttreatment, and 25 had cephalograms from 2 years or longer. **Results:** During splint therapy, the mean molar intrusion was 2.3 mm. The mean decrease in anterior face height was 1.6 mm, less than expected because of a 0.6-mm mean eruption of the mandibular molars. During the postintrusion orthodontics, the mean change in maxillary molar position was a 0.2-mm extrusion, and there was a mean 0.5-mm increase in face height. Positive overbite was maintained in all patients, with a slight elongation (<2 mm) of the incisors contributing to this. During the 1 year of posttreatment retention, the mean changes were a further eruption of 0.5 mm of the maxillary molars, whereas the mandibular molars intruded by 0.6 mm, and there was a small decrease in anterior face height. Changes beyond 1 year posttreatment were small and attributable to growth rather than relapse in tooth positions. **Conclusions:** Intrusion of the maxillary posterior teeth can give satisfactory correction of moderately severe anterior open bites, but 0.5 to 1.5 mm of reeruption of these teeth is likely to occur. Controlling the vertical position of the mandibular molars so that they do not erupt as the maxillary teeth are intruded is important in obtaining a decrease in face height. (Am J Orthod Dentofacial Orthop 2014;146:594-602)

Skeletal open bite, often called the long-face syndrome or condition, is regarded as a challenging orthodontic problem to correct. Many orthodontic treatment modalities have been used to close anterior open bites, such as extractions, multiloop edgewise archwires, high-pull headgear, chincups, bite-blocks, and functional appliances,[1-6] but relapse is common, and even the combination of headgear and a functional appliance is ineffective in changing the skeletal pattern.[7] Orthognathic surgery to reposition the maxilla superiorly has been the only way to create significant rotation of the mandible upward and forward, decreasing anterior face height along with correction of the open bite. Recently, temporary anchorage devices (TADs), including miniplates and miniscrews, have been used to intrude the maxillary posterior teeth to allow autorotation of the mandible to close an anterior open bite.[8-12]

There have been only a few reports of outcomes with this approach beyond individual case reports. Kuroda et al[13] concluded in an early article on this method that molar intrusion with TADs is as successful as surgery, but this was based on a small sample of 10 subjects. In a case series of 9 patients treated with maxillary posterior intrusion who had open bites that remained closed, Sugawara et al[14] reported a 27% to 30% relapse of the maxillary

From the Department of Orthodontics, School of Dentistry, University of North Carolina, Chapel Hill, NC.
[a]Adjunct associate professor.
[b]Kenan distinguished professor.
[c]Professor and associate dean.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
Supported in part by NIH grant DE-02115 from the National Institute of Dental and Craniofacial Research.
Address correspondence to: Nicole R. Scheffler, 373 Boone Heights Dr, Boone, NC 28607-5022; e-mail, smileboone@gmail.com.
Submitted, April 2014; revised and accepted, July 2014.
0889-5406/$36.00

http://dx.doi.org/10.1016/j.ajodo.2014.07.020

Enhanced Effect of Combined Treatment With Corticotomy and Skeletal Anchorage in Open Bite Correction

Mehmet Cemal Akay, DDS, PhD, Aynur Aras, DDS, PhD,†*
Tayfun Günbay, DDS, PhD,‡ Sercan Akyalçın, DDS,§ and
Banu Özveri Koyuncue, DDS, PhD¶

Purpose: To determine the effects of combined treatment with corticotomy and skeletal anchorage in open bite correction.

Patients and Methods: Ten patients (6 females, 4 males) with ages ranging from 15 to 25 years were involved. All of the individuals received combined subapical corticotomy and skeletal anchorage procedure and intrusion forces of 200 to 300 g were applied on the attachments of each molar and both premolars during 12 to 15 weeks. Mean changes for the measurements for the sample group were evaluated with Wilcoxon signed ranks test.

Results: Significant intrusion of maxillary posterior teeth provided counterclockwise rotation of the mandible and open bite was successfully corrected. SNB angle increased and the ANB angle decreased ($P < .05$). Significant decreases were noted for vertical skeletal characteristics and overbite increased accordingly ($P < .05$).

Conclusions: Our results indicated that the use of combined treatment with corticotomy and skeletal anchorage provided safe and noncompliance intrusion of posterior teeth in a short period and may be regarded as an alternative method for skeletal open bite correction in adults who reject orthognathic surgery.

J Oral Maxillofac Surg 67:563-569, 2009

Individuals with skeletal open bite characteristics usually have excessive eruption of posterior teeth accompanying their anterior open bite. Therefore, intrusion of maxillary posterior teeth may have a dynamic effect on overall treatment by inducing counterclockwise rotation of the mandible. However, traditional techniques are concluded to produce only relative intrusion[1] of the molars and have a limited effect in providing sound anchorage.

Holding such advantages like determination of absolute molar intrusion and requirement of minimum patient compliance, introduction of skeletal anchorage[2-11] in orthodontics has led to the replacement of conventional mechanics with temporary anchorage devices (TADs). TADs (namely miniscrews[2-5] and miniplates[6-11]) aid in anchoring orthodontic forces firmly in a desired fashion to apply all required vectors; studies report promising results for open bite treatment with maxillary molar intrusion in significant amounts.[2-5,7,10,11]

Moreover, performing a subapical corticotomy has been suggested by various authors[12,13] before the application of any intrusion mechanics on over erupted maxillary molars. Several case reports have shown that a rapid intrusion of maxillary posterior teeth may be achieved with this method.[12,13] It is widely accepted that the utilization of corticotomy before orthodontic treatment allows positively accelerated tooth movement, thereby shortening active treatment time with lesser risk of root resorption and more stable results as well.[13,14]

From the Faculty of Dentistry, Ege University, Bornova, Turkey.

*Assistant Professor, Department of Oral and Maxillofacial Surgery.

†Professor, Department of Orthodontics.

‡Professor, Department of Oral and Maxillofacial Surgery.

§Research Assistant, Department of Orthodontics.

¶Assistant Professor, Department of Oral and Maxillofacial Surgery.

This study was supported by the Department of Scientific Research Projects of Ege University, Turkey.

Address correspondence and reprint requests to Dr. Akay: Department of Oral and Maxillofacial Surgery, Ege University, Bornova, Izmir, Turkey; e-mail: cemalakay@yahoo.com

0278-2391/09/6703-0015$36.00/0
doi:10.1016/j.joms.2008.06.091

Open-Bite Malocclusion
Treatment and Stability

GUILHERME JANSON, FABRICIO VALARELLI

WILEY Blackwell

ORIGINAL ARTICLE

Treatment of severe anterior open bite with skeletal anchorage in adults: Comparison with orthognathic surgery outcomes

Shingo Kuroda,[a] Yuichi Sakai,[b] Nagato Tamamura,[b] Toru Deguchi,[c] and Teruko Takano-Yamamoto[d]
Okayama, Japan

Introduction: Skeletal anterior open bite is a difficult problem to correct in orthodontic treatment. In adults, treatment of severe skeletal anterior open bite consists mainly of surgically repositioning the maxilla or the mandible. Recently, molar intrusion by using skeletal anchorage has been developed as a new strategy for open-bite treatment. In this study, we compared treatment outcomes in patients with severe anterior open bite treated with molar intrusion by using skeletal anchorage and with orthognathic surgery. **Methods:** Twenty-three subjects with overbite less than –3.0 mm were treated with skeletal anchorage (n = 10) or with LeFort I osteotomy combined with mandibular osteotomy (n = 13). Pretreatment and posttreatment lateral cephalograms were compared. **Results:** Incisors were significantly elongated in the surgically treated subjects (4.6 mm, $P < .01$). There were no significant differences in the treatment results between skeletal anchorage and surgery, with reduced facial heights of 4.0 and 3.8 mm, and increased overbites of 6.8 and 7.0 mm, respectively. **Conclusions:** These results suggest that molar intrusion with skeletal anchorage is simpler and more useful than 2-jaw surgery in the treatment of patients with severe anterior open bite. (Am J Orthod Dentofacial Orthop 2007;132:599-605)

Skeletal anterior open bite is considered a difficult problem in orthodontic treatment. In adults, treatment of severe skeletal anterior open bite consists mainly of surgically repositioning the maxilla or the mandible. These procedures have acceptable treatment results and long-term stability.[1-4]

Recently, dental implants,[5-7] screws,[8-13] and miniplates[14-19] have been used for skeletal anchorage. Even without the cooperation of patients, these materials can provide stationary anchorage for various tooth movements. We previously reported on severe skeletal anterior open-bite patients treated with molar intrusion using titanium screws for skeletal anchorage.[11,13] In addition, there are several reports of molar intrusion with miniplates in anterior open-bite patients.[15-18] Molar intrusion with skeletal anchorage has now become a strategy for treating these patients.

From the Department of Orthodontics and Dentofacial Orthopedics, Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama University, Okayama, Japan.
[a]Assistant professor.
[b]Graduate student.
[c]Senior assistant professor.
[d]Professor and chair.
Reprint requests to: Teruko Takano-Yamamoto, Department of Orthodontics and Dentofacial Orthopedics, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, 2-5-1 Shikata-Cho, Okayama 700-8525, Japan; e-mail, t_yamamo@md.okayama-u.ac.jp.
Submitted, July 2005; revised and accepted, November 2005.
0889-5406/$32.00

doi:10.1016/j.ajodo.2005.11.046

However, it is unknown which method is better for treating severe anterior open bite—intrusion of molars with skeletal anchorage or orthognathic surgery. We have used skeletal anchorage to treat severe open-bite patients who would previously have required surgical-orthodontic treatment, with satisfactory improvement.[11,13]

In this study, we demonstrate the advantages of treatment with skeletal anchorage for molar intrusion in severe anterior open-bite patients, compared with surgical maxillary and mandibular repositioning by LeFort I osteotomy and mandibular osteotomy.

MATERIAL AND METHODS

Our subjects were 23 nongrowing patients (ages, 16-46 years; mean, 21.6 years; SD 7.3 years) with anterior open bite more than 3.0 mm (mean, 5.2 mm; SD 2.3 mm) with skeletal Class I or Class II (ANB angle >1.5°) jaw-based relationships (Table I).[20]

Ten female patients were orthodontically treated with molar impaction by using skeletal anchorage (implant group). One patient had a temporomandibular disorder (TMD) before treatment. Mean overbite at pretreatment was −5.2 mm (SD 1.8 mm), and the mandibular plane angle was 38.8° (SD 6.4°). The miniplates (SAS system; Dentsply-Sankin, Tokyo, Japan) or the titanium screws (intermaxillary fixation screw, Keisei Medical Industrial, Tokyo, Japan; diameter, 2.3 mm; length, 11 mm) were placed under local anesthesia

Original Article

Long-term stability of soft tissue changes in anterior open bite adults treated with zygomatic miniplate-anchored maxillary posterior intrusion

Eiman S. Marzouk[a]; Hassan E. Kassem[a]

ABSTRACT

Objectives: To evaluate soft tissue changes and their long-term stability in skeletal anterior open bite adults treated by maxillary posterior teeth intrusion using zygomatic miniplates and premolar extractions.

Materials and Methods: Lateral cephalograms of 26 patients were taken at pretreatment (T1), posttreatment (T2), 1 year posttreatment (T3), and 4 years posttreatment (T4).

Results: At the end of treatment, the soft tissue facial height and profile convexity were reduced. The lips increased in length and thickness, with backward movement of the upper lip and forward movement of the lower lip. The total relapse rate ranged from 20.2% to 31.1%. At 4 years posttreatment, 68.9% to 79.8% of the soft tissue treatment effects were stable. The changes in the first year posttreatment accounted for approximately 70% of the total relapse.

Conclusions: Soft tissue changes following maxillary posterior teeth intrusion with zygomatic miniplates and premolar extractions appear to be stable 4 years after treatment. (*Angle Orthod.* 0000;00:000–000.)

KEY WORDS: Anterior open bite; Zygomatic miniplates; Soft tissue; Posterior segment intrusion; Premolar extractions; Long-term stability

INTRODUCTION

Facial esthetics may be the incentive for seeking orthodontic treatment, particularly in adults. The orthodontist is routinely asked about the impact of different treatment options on the soft tissue of the face.[1]

The change in soft tissue profile produced by tooth movement has diverse characteristics that cannot be calculated or simply defined by an exact formula.[2] It has been shown that there is a large variability in the soft tissue response to tooth movement.[3] Several cephalometric soft tissue analyses have been introduced for the purposes of treatment planning and outcome evaluation of the different treatment modalities on the integumental profile.[4–6]

Skeletal open bite classically presents with excessive posterior facial height, anterior open bite, and a retruded chin, hence it is considered a challenging orthodontic problem particularly in adults where growth modification is no longer a treatment option. Incisor extrusion to close the anterior open bite falls short of improving the skeletal problems underlying the facial deformity and is limited by the extent of esthetically acceptable incisor display. Thus, for improving facial esthetics, orthognathic surgery has been the preferred treatment option for adult patients with skeletal open bite.[7–9]

The introduction of temporary anchorage devices expanded the envelope of discrepancies that could be treated by orthodontic tooth movement to include cases traditionally treated with orthognathic surgery. In skeletal open bite malocclusions, miniplates and miniscrews have been used to intrude maxillary posterior teeth to produce autorotation of the mandible, thus reducing the excessive facial height, closing the anterior open bite, achieving lip competence, and improving chin projection.[10–19]

Previous studies[10–12,14–19] mostly reported the skeletal and dental effects of posterior intrusion with skeletal anchorage in skeletal open bite patients. Deguchi et al.[13] compared orthodontic treatment outcomes for open bite cases treated with premolar extractions using either conventional edgewise orthodontic treat-

[a] Lecturer, Department of Orthodontics, Faculty of Dentistry, Alexandria University, Alexandria, Egypt.

Corresponding author: Dr Eiman S. Marzouk, Department of Orthodontics, Faculty of Dentistry, Alexandria University, Champinion Street, Azarita, Alexandria, Egypt
(e-mail: eimanmarzouk39@gmail.com)

Accepted: October 2017. Submitted: July 2017.
Published Online: November 15, 2017

Kassem and Marzouk *Progress in Orthodontics* (2018) 19:13
https://doi.org/10.1186/s40510-018-0213-5

Progress in Orthodontics

RESEARCH Open Access

Prediction of changes due to mandibular autorotation following miniplate-anchored intrusion of maxillary posterior teeth in open bite cases

Hassan E. Kassem and Eiman S. Marzouk*

Abstract

Background: Prediction of the treatment outcome of various orthodontic procedures is an essential part of treatment planning. Using skeletal anchorage for intrusion of posterior teeth is a relatively novel procedure for the treatment of anterior open bite in long-faced subjects.

Methods: Data were analyzed from lateral cephalometric radiographs of a cohort of 28 open bite adult subjects treated with intrusion of the maxillary posterior segment with zygomatic miniplate anchorage. Mean ratios and regression equations were calculated for selected variables before and after intrusion.

Results: Relative to molar intrusion, there was approximately 100% vertical change of the hard and soft tissue mention and 80% horizontal change of the hard and soft tissue pogonion. The overbite deepened two folds with 60% increase in overjet. The lower lip moved forward about 80% of the molar intrusion. Hard tissue pogonion and mention showed the strongest correlations with molar intrusion. There was a general agreement between regression equations and mean ratios at 3 mm molar intrusion.

Conclusions: This study attempted to provide the clinician with a tool to predict the changes in key treatment variables following skeletally anchored maxillary molar intrusion and autorotation of the mandible.

Keywords: Intrusion, Skeletal anchorage, Miniplates, Autorotation, Prediction, Regression

Background

The visualization of the treatment outcome of orthodontic therapy is an indispensable tool in the orthodontist armamentarium [1]. Prediction of the change in the orofacial complex has been given a lot of attention in the orthodontic literature. Orthodontists have been interested in predicting the changes due to growth [2, 3]. A lot of emphasis has been given to the prediction of changes in the soft tissues of the face which brought about orthognathic surgery [4, 5]. Prediction of the soft tissues following orthodontic tooth movement was reported particularly in lip response to premolar extraction and anterior retraction [6].

The advent of skeletal anchorage opened the door to treating many skeletal problems where orthognathic surgery has been classically the treatment of choice. Skeletal open bite and the long face syndrome are clear examples [7]. The classical orthognathic surgery involves Le Fort maxillary impaction with or without mandibular surgery. Most of the favorable effects were induced by the autorotation of the mandible, namely reduction of the skeletal and soft tissue facial heights, increase in the projection of hard and soft tissue chin points, reduction of the overjet, and increase of the overbite. In addition, the lower lip position changed with the autorotation of the mandible.

To serve the purpose of cephalometric prediction tracing, several authors attempted to relate the change in soft tissue projection to the degree of mandibular autorotation. Proffit [8] estimated that both the lower lip and soft tissue chin rotate at a ratio of 1:1 with the rotation of the mandible. Soft tissue chin point rotated at a 1:1 ratio with the hard tissue chin point on the same arc [9].

* Correspondence: eimanmarzouk39@gmail.com
Department of Orthodontics, Faculty of Dentistry, Alexandria University, Alexandria, Egypt

Alsafadi et al. Progress in Orthodontics (2016) 17:9
DOI 10.1186/s40510-016-0122-4

Progress in Orthodontics
a SpringerOpen Journal

REVIEW Open Access

Effect of molar intrusion with temporary anchorage devices in patients with anterior open bite: a systematic review

Ahmad Saleem Alsafadi[1*], Mohannad M. Alabdullah[1], Humam Saltaji[2], Anas Abdo[3] and Mohamed Youssef[1]

Abstract

Objective: The objective of the study is to assess the effect of molar intrusion with temporary anchorage devices on the vertical facial morphology and mandibular rotation during open bite treatment in the permanent dentition.

Methods: We performed a systematic review of the published data in seven electronic databases up to September 2015. We considered studies for inclusion if they were examining the effects of posterior teeth intrusion on the vertical facial morphology with open bite malocclusion in the permanent dentition. Study selection, risk of bias assessment, and data-extraction were performed in duplicate. Meta-analysis was not possible due to dissimilarity and heterogeneity among the included studies.

Results: Out of the 42 articles that met the initial eligibility criteria, 12 studies were finally selected. Low level of scientific evidence was identified after risk of bias assessment of the included studies with no relevant randomized controlled trial performed. Out of the 12 selected studies, five studies used miniplates and seven studies used miniscrews. Mandibular counterclockwise rotation was found to be between 2.3° and 3.9° in six studies (as sassed by mandibular plane angle, between MeGo or GoGn and SN or FH plane) while it was less than 2° in the remaining studies.

Conclusions: Current weak evidence suggests that molar intrusion with temporary anchorage devices may cause mandibular counterclockwise autorotation. Future well-conducted and clearly reported multicenter randomized controlled trials that include a non-treatment control group are needed to make robust recommendations regarding the amount of mandibular rotation during open bite treatments.

Keywords: Systematic review, Skeletal open bite, Molar intrusion

Review

Introduction

Open bite malocclusion is considered one of the most difficult orthodontic problems to correct because it appears as a result of the interaction of numerous etiological factors (genetic, dental, skeletal, functional, soft tissue, and habit) that contribute to its development [1]. An open bite can occur unilaterally or bilaterally in the buccal segments; it is particularly seen in the anterior teeth. Generally, different features have been found to be associated with the skeletal anterior open bite distinguishing it from other types of malocclusion including increased lower face height, short posterior face height, [2] increased gonial and mandibular plane angles, [3] and increased maxillary molar dentoalveolar height [4]. Several reports have found correlations between orofacial muscle activity and vertical facial morphology [5–8]. These studies showed positive relationships between anterior open bite and weak musculature.

Various therapeutic approaches have been proposed for the treatment of an anterior open bite. These approaches vary depending on the causative factors and involve myotherapy, preventive treatment, functional therapy, orthognathic surgery, and orthodontic treatment using

* Correspondence: alsafadisaleem10@gmail.com
[1]Department of Orthodontics, Faculty of Dentistry, Damascus University, Damascus, Syria
Full list of author information is available at the end of the article

Saudi Journal of Oral Sciences

REVIEW ARTICLE

Stability of anterior open bite correction treated with posterior teeth intrusion using temporary anchorage devices. A systematic review

Mohammed K. Al-Dhubhani

Private Practice, Asser Province, KSA

Abstract

Anterior open bite (AOB) could be corrected by intrusion of the posterior teeth using temporary anchorage device (TAD). However, stability of such approach is still not obvious. The aim of this paper is to systematically review the available scientific evidence regarding the stability of AOB correction on treated with posterior teeth intrusion using TADs. Electronic databases and certain orthodontic journals were searched. Randomized controlled trials (RCTs), nonRCTs (nRCTs), and retrospective studies (RTSs) investigating the stability of AOB correction treated with intrusion of maxillary, mandibular posterior teeth or both using any type of TAD were retrieved. Both reviewers were involved in data extraction and analysis, and any disagreements were resolved by discussion. Three RTSs and one nRCT were recognized. Low level of scientific evidence was identified after assessment of the risk of bias of the involved studies with no related RCT was performed. Although, overbite relapsed after debonding, positive overbite is maintained in all 95 participants of the involved studies. Overbite relapse could not be explained by the relapse of posterior teeth intrusion only. Weak scientific evidence supports that correction of the AOB by posterior teeth intrusion using TAD is stable approach at the short and long term.

Key words: Miniplates, miniscrews, molar intrusion, open bite, orthodontic, systematic

Introduction

Nonsurgical correction of anterior open bite (AOB) is usually a difficult task for any orthodontist mainly because of high relapse tendency. Skeletal, dental, respiratory, neurologic, or habitual factors are all possible etiological factors.[1] The treatment of AOB is usually aimed at obtaining an adequate amount of overlap of the maxillary and mandibular anterior teeth. Various treatment modalities were suggested in the literature for the treatment of AOB, the typical approach is orthodontic extrusion and retroclination of the anterior teeth, however, such treatment aimed only at camouflaging the underlying skeletal discrepancy. More sophisticated treatment modality is a combination of orthodontic and orthognathic surgical treatments in adulthood and more recently intrusion of posterior teeth by means of temporary anchorage devices (TADs).[2-4]

Several authors reported successful true maxillary molar intrusion for the treatment of open bite, increased facial height, and supraerupted maxillary molars.[5,6] Scheffler *et al*.[7] found that a mean of 2.3 mm of true maxillary molars could be obtained using TAD. However, molars could be intruded up to 8 mm depending on their initial position and treatment targets.[8]

Address for correspondence:
Dr. Mohammed K. Al-Dhubhani, Private Practice,
Asser Province, KSA.
E-mail: dr.mkm@hotmail.com

Access this article online

Quick Response Code:

Website: www.saudijos.org

DOI: 10.4103/sjos.SJOralSci_21_18

Cite this article as: Al-Dhubhani MK. Stability of anterior open bite correction treated with posterior teeth intrusion using temporary anchorage devices. A systematic review. Saudi J Oral Sci 2018;5:69-74.

Progress in Orthodontics

REVIEW Open Access

Stability of anterior open bite treatment with molar intrusion using skeletal anchorage: a systematic review and meta-analysis

Daybelis González Espinosa[1,2], Paulo Eliezer de Oliveira Moreira[1], Amanda Silva da Sousa[1], Carlos Flores-Mir[3] and David Normando[1*]

Abstract

Objectives: The aim of this systematic review and meta-analysis is to assess the degree of stability of anterior open bite (AOB) treatment performed through the molar intrusion supported with skeletal anchorage at least 1 year posttreatment.

Methods: This study was registered in PROSPERO (CRD42016037513). A literature search was conducted to identify randomized (RCT) or non-randomized clinical trials based including those considering before and after design. Data sources were electronic databases including PubMed, Cochrane Library, Science Direct, Google Scholar, Scopus, Lilacs, OpenGrey, Web of Science, and ClinicalTrials.gov. The quality of evidence was assessed through the JBI tool and certainty of evidence was evaluated through the GRADE tool. Random effects meta-analysis was conducted when appropriate.

Results: Six hundred twenty-four articles met the initial inclusion criteria. From these, only 6 remained. The mean posttreatment follow-up time was 2.5 years (SD = 1.04). The overbite showed a standardized mean relapse of − 1.23 mm (95% CI − 1.64, − 0.81, $p < 0.0001$). Maxillary and mandibular incisors presented a non-significant mean relapse, U1-PP − 0.04 mm (95% CI − 0.55, 0.48) and L1-MP − 0.10 mm (95% CI − 0.57, 0.37). Molar intrusion showed a relapse rate around 12% for the maxillary molars and a 27.2% for mandibular molars.

Conclusion: The stability of AOB through molar intrusion using TADs can be considered relatively similar to that reported to surgical approaches, since 10 to 30% of relapse occurs both in maxillary and mandibular molars. The level of certainty ranged between very low and low. RCTs reporting dropout during the follow-up are in dire need.

Keywords: Open bite, Skeletal anchorage, Molar intrusion, stability

* Correspondence: davidnormando@hotmail.com
[1]Department of Orthodontics, Faculty of Dentistry, Dental School, Federal University of Pará (UFPA), Augusto Correa St., no. 1, Belém, Pará 66075-110, Brazil
Full list of author information is available at the end of the article