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OPCIONES DE TRATAMIENTO DE MALOCLUSIONES DE CLASE III EN EL PACIENTE EN CRECIMIENTO

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Resumen :

Introducción : Las maloclusiones de clase III son de las más complejas en tratar debido al componente multifactorial. Son una interrelación entre componente genético hereditario y factores medioambientales. La discrepancia maxilomandibular no tratada engendra repercusiones dentales, en tejidos blandos y posturales. El tratamiento precoz mejora el pronóstico, disminuye las repercusiones y subsecuentes necesidades ortodónticas y quirúrgicas. Distintas opciones se presentan según las características de los pacientes.

Objetivos : el objetivo principal fue detallar las opciones de tratamiento de las clases III. Dentro de los objetivos secundarios encontramos determinar la edad idónea, estimar los éxitos / recidivas de dichos tratamientos y detallar sus límites.

Metodología : se estudiaron artículos encontrados en *Pubmed* y Medline complete con las palabras claves *class III, treatment appliances, maloclusion, biotype, caracteristics, children* y con los criterios de inclusión : maxilar, crecimiento, publicación reciente, evolución tratamiento. Fueron descartados artículos tratando de clase III no maxilar, asociada a síndrome, artículos de ortodoncia o cirugía solo. Se analizaron 38 referencias de los 165 encontradas para presentar los diversos protocolos, resultados y limitaciones.

Resultados : En 17 de los artículos comparados se logró una mejora de la maloclusión. En 14 de ellos se observó una mejora del Wits, ANB, SNB, recorrido de la arcada, corrección del resalte, y movilización de las suturas circumaxilares en tratamientos precoces. En 7 de ellos, se referenciaron efectos indeseados respecto a movimientos dentarios y crecimiento divergente.

Estos efectos estuvieron minimizados dependiendo de la secuencia de tratamiento y dispositivos. De las referencias, 6 acuerdan la mayor estabilidad al Hyrax y mascara. En 5 artículos el protocolo Alt-RAMEC es más efectivo.

Conclusiones : el protocolo elegido fue determinado por las características del paciente, los 7 años constituyeron la edad idónea. El conjunto disyuntor / mascarilla presentaron menos recidiva y los TSADs como el “futuro” de la ortopedia.

Abstract :

Introduction : *The class III malocclusions are one of the most complex to treat due to the multifactorial component. It exists an interrelation between hereditary genetic component and environmental factors. Untreated maxillomandibular discrepancy led to dental, soft tissues, and postural repercussions. Early treatment improves the prognosis and reduces the repercussions and subsequent orthodontic and surgical needs. Different options are presented depending on the characteristics of the patients.*

Objectives : *The main objective is to detail the treatment options for class III. Among the secondary objectives we find determining the ideal age, estimating the success / relapses of said treatments and detailing their limits.*

Methodology *: Articles found in Pubmed and Medline complete with the following key words class III, treatment appliances, maloclusion, biotype, caracteristics, children and with the following inclusion criterias will be studied: class III maxilla, growth, recent publication, treatment evolution. Articles only dealing with non-maxillary class III, associated with syndrome, articles about orthodontic or surgery were discarded. 38 references of the 165 found will be analyzed to present the various protocols, results and limitations.*

Results: *In 15 of the articles compared, an improvement of the malocclusion was achieved. In 14 of them an improvement in Wits, ANB, SNB, arch length, overjet correction, and mobilization of the circumaxillary sutures was observed in early treatment. In 7 of them, undesired effects are indexed regarding tooth movements and divergent growth. These effects*

were minimized depending on the sequence of treatment and devices. Of the references, 6 agreed the best stability to the hyrax and facemask. In 5 articles, the Alt-RAMEC protocol is more effective.

Conclusions: *The choosen protocol is determined by the characteristics of the patients, the ideal age is around 7 years old. The combination of distalizer / facemask presents less relapse and the TADs are the future of orthopedics.*

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Introducción

En 1899 Edward H. Angle propuso una clasificación de las maloclusiones dentales basándose en la relación intermolar de los primeros molares. “El padre de la ortodoncia moderna” ha basado su clasificación según la zona donde ocluye la cúspide mesiovestibular superior (CMVs) respecto a la fosa mesiovestibular inferior (FMVi) de los primeros molares definitivos. Si la CMVs se encuentra en posición mesial referente a la FMVi hablaremos de clase II. Por el contrario si la CMVs ocluye en posición distal de la fosa se considerará una clase III. Si la cúspide ocluye exactamente en la fosa tratará de una clase I siendo la oclusión intermolar la más deseable (1). No obstante, esta clasificación ha sido rápidamente incompleta presentando carencia en las formas de diagnosticar y en relación con la amplitud de las maloclusiones observadas en los diferentes grupos de pacientes (2). Igualmente existe un otro tipo de clase III que es la clase asociada a los caninos : en clase III canina, la punta de la cúspide superior ocluye en posición distal al punto de contacto entre el premolar inferior y el canino inferior.

A lo largo del tiempo la clase III ha sido asociada a la posición de la mandíbula respecto al maxilar ; siendo esta primera en posición mesial respecto a su antagonista. Tweed en 1966 amplió esta clasificación de 1899 para involucrar características y crear subcategorías. Tweed dividió la clase III en dos categorías : (3)

- Categoría A : se observa una mandíbula de tamaño cefalométrico normal, se habla de seudoclase III.

- Categoría B : anomalía de desarrollo de los maxilares, siendo compatible con un hipodesarrollo del maxilar y/o un hiperdesarollo de la mandíbula. Se habla de clase III esquelética.

Luego Moyers (4) propuso una clasificación cada vez más detallada enfocándose en tres potenciales etiologías de las clases III : ósea, neuromuscular o dentaria.

La prevalencia de la clase III es muy variable dependiendo del origen étnico (5)(6), está relativamente baja en el tipo caucásico ; 1,5-5% respecto al tipo asiático donde culmina hasta los 19%. Hardy, Cubas y Orellanas (7) encontraron una prevalencia hasta 26,7% en una revisión de 20 artículos tratando de la prevalencia de esta maloclusión. Sin embargo, a pesar de esta discrepancia de prevalencia las conclusiones coinciden en la atribución de prevalencia incrementada en los países asiáticos.

En este trabajo nos enfocaremos sobre las maloclusiones tipo III de origen esquelético - según las clasificaciones realizadas por Moyers (4) y Tweed (3) – de origen maxilar en niños en crecimiento.

El diagnóstico de las maloclusiones de clase III puede ser realizado de varias formas tal como lo refleja la amplia clasificación disponible. Uno de los métodos más extendido es el estudio cefalométrico (8) que puede ser estudiado según el análisis de varios autores. En un estudio de Reyes et al. (8) estudiaron el crecimiento facial de 949 niños de clase III sin tratamiento de los 6 a los 16 años. Los estudios cefalométricos fueron realizados con 71 puntos de referencia bajo el análisis de Steiner, Jacobson, Ricketts y McNamara. Los puntos de referencia claves en el diagnóstico de las clases III son los siguientes (9) :

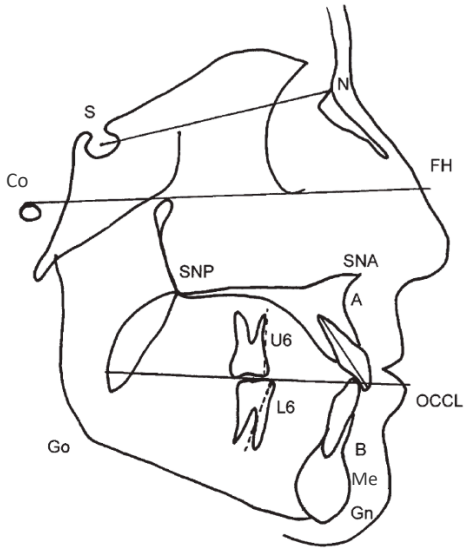

Figura 1 : puntos y trazos cefalometricos (10)

- Ángulo SNB : ángulo en el punto N (nasion) entre las líneas que se sitúan entre la silla turca (S) y N y por otro lado el punto B (punto más profundo de la concavidad anterior de la mandíbula) y N. Según Riedel, un SNB aumentado de 2° respecto al valor normal de 78° ± 3° en dentición mixta y 80° ± 3° corresponde a un adelantamiento de la mandíbula.
- Ángulo SNA : ángulo en el punto N formado por las líneas S-N y N-A (A : punto más profundo de la concavidad anterior del maxilar). Un valore de SNA < 79° refleja una retrusión del maxilar según Riedel.
- Ángulo ANB : Ángulo medido entre las dos líneas formadas por el punto A y N y por el otro lado la línea entre B y N. Un ANB disminuido de más de 3° respecto al valor normal de 4° en dentición mixta y 2° en dentición permanente corresponde a una relación intermaxilar deficiente.
- Un triángulo “de McNamara” puede ser establecido con el fin de relacionar el tamaño longitudinal de la mandíbula con el maxilar. Este triángulo está dado por la relación entre los puntos Cóndilo (Co)-A, A-Mentón (Me) y Co-Me. El triángulo de McNamara permite definir cuál de los dos está originando la clase III.

Las diferentes maloclusiones asociadas a las clases III son amplias, pueden venir asociadas a un síndrome craneofacial dimórfico tal como la trisomía 21 o bien la acondroplasia (5). El conjunto de síntomas llamado síndrome asociado a clase III es muy variable dependiendo de la etiología y de las diferentes interacciones ambientales / individuales. La etiología de dicha clase y las variaciones interindividuales determinarán las opciones de tratamiento posibles. Un estudio de las características individuales y de la cefalometría permite establecer un diagnóstico precoz de clase III en niños en crecimiento (6). En cuanto a las maloclusiones McNamara et al. (11) detallaron que, según un estudio de Dietrich un 26% de la población con dentición decidual presentaba una retrusión maxilar, un 44% de la población con dentición mixta y 37% de la población con dentición permanente. Cabe señalar que este estudio se basa en los valores cefalométricos de ANB que coinciden con clases III esqueléticas entonces no está basado sobre la relación intermolar. Las maloclusiones de origen esqueléticas suelen asociarse a una compensación dentaria que se traduce por una retroinclinación de los incisivos inferiores y una proinclinación de los incisivos superiores (6). Igualmente la clase III se suele vincular con una mordida cruzada anterior y/o posterior (esta última por falta de crecimiento transversal del maxilar) y un perfil recto, pero con mayor frecuencia cóncavo (en cefalometría se traduce por una posición adelantada del punto B respecto al punto A) (12).

Una oclusión incorrecta no solo tiene repercusiones en la aérea maxilofacial, sino también en el resto del cuerpo : en efecto según Bardellini et al. (13) las clases III se asocian con frecuencia a una posición baja de la lengua lo que tendrá repercusiones en estructuras tal como el hueso hioideo y la postura. En un estudio sobre una niña de 5 ½ años tratada con una evolución del Bionator : el Mouth Slow Balance (MSB) se observó una mejora de la repartición

del peso entre los pies y una mejora del centro de gravedad lo que permitió ajustar la postura de la niña cuando se reevaluó a sus 12 años.

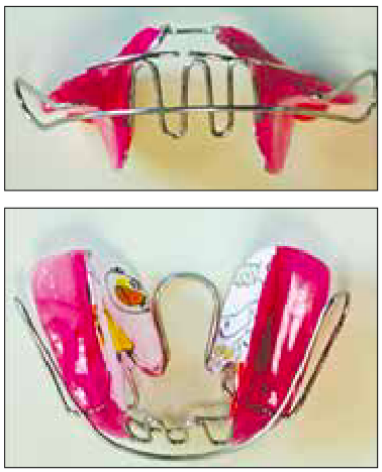

Figura 2 : MSB (mouth slow balance) de clase III (13)

El tratamiento de las clases III y la estabilidad de dicho tratamiento representa un reto importante en ortodoncia (12). En efecto un tratamiento precoz usando una combinación de ortopedia y ortodoncia permite mejorar el pronóstico de este tipo de maloclusión. Está admitido que el tratamiento precoz disminuye la incidencia de tratamientos que se realizarán en dentición permanente tal como el camuflaje ortodóntico y/o la cirugía ortognática (14). El objetivo de la ortopedia es la aplicación de fuerzas suficientes para lograr una distracción de las suturas perimaxilares : nasomaxilar, frontomaxilar, etmoidomaxilar, cigomáticomaxilar y palatina transversal y cigomático palatina. Según Delaire (15) las suturas fronto nasal y fronto maxilares son las que permiten rotar toda la pirámide del maxilar, pero para Bacetti y McNamara (16) son las palatina transversal y la cigomático palatina las que permiten un mayor desplazamiento del maxilar. El objetivo primario de los tratamientos ortopédicos es la movilización de la pirámide maxilar para corregir la relación intermaxilar : para lograr esto las fuerzas aplicadas son

frecuentemente superiores a 400 gr por lado (17). En acuerdo con Melsen (18) la osificación de las suturas empieza a dificultar la ortopedia al torno de la pubertad (11-13 años) entonces los actos ortopédicos tendrán que realizarse lo más antes posible. La tracción del maxilar tiene que realizarse de forma rigurosa ; en efecto cada elemento tiene un centro de resistencia (CR). Dependiendo de como aplicaremos la fuerza obtendremos un movimiento de gresión (adelantamiento puro) si el vector de fuerza pasa por el CR o de versión (adelantamiento con angulación) si el vector no pasa por el CR. El CR del maxilar se puede determinar de la siguiente forma :

En una imagen de cefalometría se traza el plano oclusal y su paralela que pasa por el punto infraorbitario. Luego se traza la perpendicular a los dos planos que pasa por distal del primer molar. El CR se localiza sobre la perpendicular a la equidistancia de los dos planos paralelos.

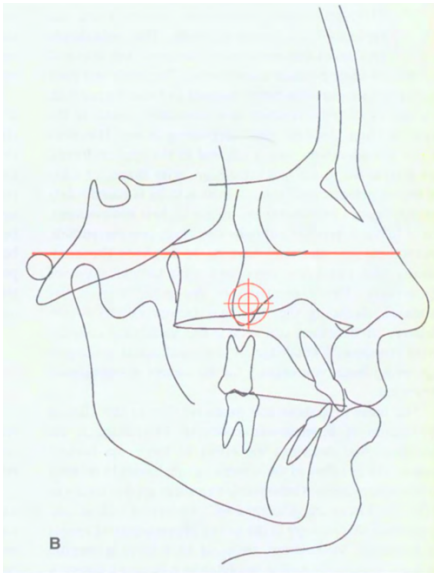

Figura 3 : centro de resistencia del maxilar (19)

En consonancia con Phillip M. Campbel (20) un tratamiento precoz : cuando los incisivos centrales y laterales maxilares además de los primeros molares están erupcionados (en torno a

los 6-8 años) permite mejorar el pronóstico en las clases III. No obstante, en caso de una protracción maxilar con anclaje óseo y elásticos de clase III está reportado que la máxima eficiencia se logra en dentición mixta segunda fase / temprana dentición definitiva (21). Existe un otro parámetro que permite determinar si hará falta o no un tratamiento quirúrgico : "el análisis de *Wits*" (6). El valor de *Wits* se obtiene trazando en una cefalometría lateral del cráneo las perpendiculares en los puntos A y B respecto al plano oclusal y midiendo la distancia entre las dos intersecciones.

- *Wits* de 0 a -5mm : la clase III se puede resolver mediante la aplicación de ortopedia y ortodoncia
- *Wits* de -4mm a -12mm : se necesitan estudios cefalométricos adicionales antes de asegurar la decisión quirúrgica.

Una revisión sistemática dirigida por De Toffol et al. (14) en 19 artículos corroboró la efectividad del tratamiento precoz de las clases III en un 75% de los casos ; sin embargo, una revisión sistemática y meta análisis (22) encontró una efectividad moderada del tratamiento precoz, pero concluyó la necesidad de estudios de mayor duración.

En cuanto a los tratamientos disponibles han ido mejorando a lo largo de las décadas, les podemos dividir en dos grandes entidades : los tratamientos de ortopedia y de ortodoncia. Pueden ser intraorales o bien extraorales y presentarse de forma fija o removible. Los aparatos y los protocolos se eligen según el tipo de maloclusión, la adaptabilidad de los pacientes y la severidad.

I. Aparatos de ortopedia

A. Máscara de protracción

Considerando que el hipodesarrollo del maxilar tiene una prevalencia hasta un 40% en las maloclusiones de clase III (11) uno de los objetivos principales es favorecer su crecimiento. Estas máscaras son bastante usadas en el tratamiento de las maloclusiones tipo III (14). El uso de las máscaras ha sido muy influenciado por Jean Delaire que está considerado como el precursor de la tracción mediante este dispositivo (23).

Las máscaras de protracción tienen limitaciones per se. Están indicadas para pacientes con tendencia de crecimiento braquifacial o mesofacial. Sin embargo, no están indicadas en los dolicofaciales.

Las máscaras de protracción tienen como efecto la inducción de un giro horario de la mandíbula al crear una fuerza de apoyo sobre esta. También al realizar una tracción del maxilar (24) se produce un alargamiento de la longitud de la arcada lo que limita la necesidad de exodoncias de primeros molares en caso de tener una discrepancia óseo dentaria negativa. De forma general estos dispositivos realizan un avance del tercio medio de la cara y no solo del maxilar.

Existen dos tipos de máscaras las de Delaire y de Petit. Ambas difieren en cuanto al lugar de aplicación de la fuerza.

La máscara facial de Delaire (25) : Este dispositivo consta de dos barras rígidas cuadradas verticales laterales extraorales ancladas sobre dos regiones : la frente y el mentón y una barra transversal a altura del maxilar que consta de dos anclajes para los elásticos. Las dos regiones de apoyo suelen ser de plástico. Las tres barras se relacionan mediante cilindros de

acero inoxidable. Cada elemento se puede adaptar con el fin de ajustarse a las anchuras faciales del paciente.

Las fuerzas que se suelen aplicar suelen ser a entorno de 1kg en total (10 Newtons) en la región de los caninos levemente encima del plano oclusal (26) y dirigidas a 30° a bajo y adelante debido a los centros de resistencia de la arcada superior y de la estructura maxilar. Esta tracción se aplica durante 12 a 24 horas al día : permite lograr una rotación horaria del maxilar y un avance hasta 0,24 mm al mes (24). Además se observará una extrusión y vestíbuloversión de los incisivos superiores. Respecto al apoyo mentoniano ha sido observado una lingulo versión de los incisivos inferiores (24).

Figura 4 : Máscara facial de Delaire tracción de 20-30° (27)

La máscara facial de Petit (24) *:* ha sido desarrollada posteriormente a la de Delaire y la diferencia básica viene en su diseño : lleva una barra vertical en vez de dos. No obstante, se suele utilizar menos que la máscara de Petit porque según los pacientes es menos confortable al favorecer el estrabismo.

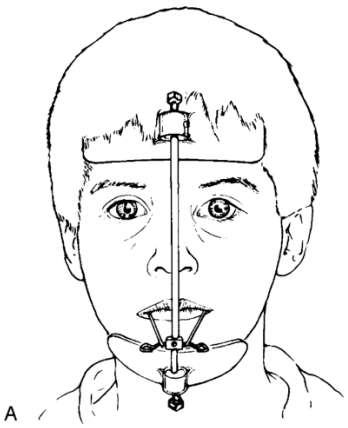

Figura 5 : Máscara facial de Petit vista frontal (16)

La transmisión de estas fuerzas se realiza intraoralmente mediante un anclaje por un bi arco de Delaire (en sí mismo la máscara no provoca distracción de la sutura palatina, sino su movimiento) que consiste en dos arcos : un arco vestibular y un arco lingual soldados entre ellos a nivel de bandas en los primeros molares definitivos (25). Luego se pueden añadir elementos de distracción tipo Hyrax o placa con tornillo de extensión y si se precisa en caso de mordida profunda levantes de mordida posteriores.

Las máscaras según De Clerck (24) deben ser utilizadas antes de los 9 años si se quiere lograr una tracción óptima. La fuerza aplicada se sitúa al torno de los 350-450 gr por lado durante 12 a 14h al día (12).

Keles et al. investigó (26) sobre las consecuencias y subsecuentes ventajas de variar la dirección de las fuerzas en las protracciones ortopédicas. Se utilizó un *reverse Headgear* cuyo diseño permite traccionar a nivel del CR. Consiste en un tubo de fuerza extra bucal mesial a los primeros molares superiores y un arco que se pliega para colocar los elásticos a altura del centro de resistencia del maxilar.

Se opone a la tracción no modificada en el hecho de que en la tracción “tradicional” la aplicación de la fuerza se ejecuta a altura del CR de la arcada superior y no del maxilar.

Lo que se logró fue una translación del maxilar sin rotación de este, una rotación horaria del plano oclusal acompañada de extrusión y versión lingual de los incisivos superiores. Además se observó una rotación horaria de la mandíbula y retroinclinación de los incisivos inferiores.

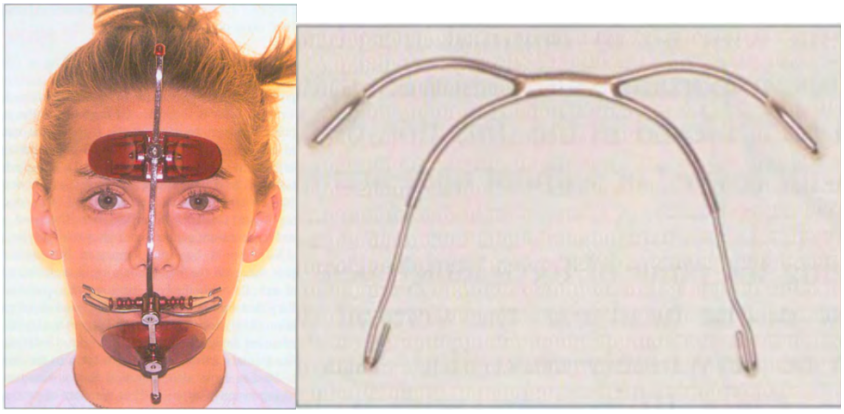

Figura 6 : A. Reverse headgear vista frontal y B. arco headgear (19)

Los inconvenientes de las máscaras de protracción son varias : en dolicofaciales ocasionan un giro horario indeseado y suelen provocar una acción dentaria indeseable (versión de los incisivos, extrusión de piezas posteriores y/o anteriores). También como referido preliminarmente la máscara de Petit tiene la particularidad de ser referida como incómoda por los pacientes por la tendencia al estrabismo que ocasiona. Para limitar el movimiento dental de molares y caninos, estos se podrán anquilosar de forma voluntaria para que funcionen como anclajes naturales. Debido a la localización del CR será más conveniente utilizar los caninos maxilares. (12)

B. La mentonera

La mentonera solo tiene efecto a nivel del maxilar inferior, pero su control resulta muy complejo y con efectividad relativa (24). Se suele dirigir a pacientes con hiperdesarrollo mandibular e hipodivergencia de los planos. Empero, sí que se puede usar en caso de predominancia de hipodesarrollo maxilar en combinación con tratamientos de tracción ortopédicos del maxilar. (24).

C. Anclajes óseos (miniplacas y minitornillos) (24,28)

Este tipo de anclaje se basa en el uso de miniplacas/minitornillos que se denominan implantes temporales o TSADs, de sus siglas en ingles, *Temporary Skeletal Anchorage Devices* (TSADs). Las ventajas que tienen son que son baratos, más pequeños, tardan menos tiempo en cicatrizar que los implantes protésicos y hacen que el uso de dientes como anclajes naturales no es más necesario. Estos dispositivos proporcionan un anclaje absoluto que se define por la "ausencia de movimiento de la unidad de anclaje a consecuencia de la reacción a la fuerza ejercida para desplazar una unidad" (29). Han sido diseñados especialmente para la ortodoncia.

Los minitornillos suelen ser de Titanio o titanio alloy y medir unos 1,2 / 2,2 mm de diámetro y de 5 mm hasta 15 mm de altura. Se colocan de forma transmucosa y la inserción puude ser realizada directamente por el odontólogo. Sin embargo, hay riesgos de fallo alto por sesgos en el posicionamiento : daño radicular apical, limitación de la movilización posterior del diente y la creación de un momento puede desatornillar los minitornillos. (28)

Las miniplacas generalmente de titanio constan de tres partes : (30)

- La cabeza donde se ancla el dispositivo ortopédico puede presentar un gancho, un tubo o un oval.
- El brazo que es transgingival.
- El cuerpo subperióstico y fijado mediante 2 o 3 tornillos de fijación al hueso, puede ser en forma de T, L, Y o I. En el maxilar se fijan mediante tres tornillos y en la mandíbula mediante dos. (28)

El hecho de elegir una forma u otra viene determinado por varios parámetros a saber el lugar de inserción, la densidad óseas (número de tornillos), profundidad del vestíbulo y necesidades terapéuticas.

Las miniplacas deben ser colocadas por un cirujano mediante la realización de un colgajo mucoperióstico : se suelen colocar en la cresta infra cigomática y en el ámbito de la región canina mandibular.

Por ser colocadas de forma apical a la raíz no hay dificultad en la movilidad posterior del diente. Estos dispositivos permiten una mejor estabilidad del anclaje por no favorecer la creación de un momento (en oposición a los mini tornillos) y, entonces, la posible aplicación de fuerzas mayores tal como las que se utilizan en ortopedia.

Existen tres categorías principales de miniplacas : (31–33)

- El SAS – de su denominación en ingles *skeletal anchorage systeme* – de Sugawara : la cabeza de la placa comporta tres ganchos lo que permite variar la tracción. Sobre todo tiene aplicación en la distalización de los molares.

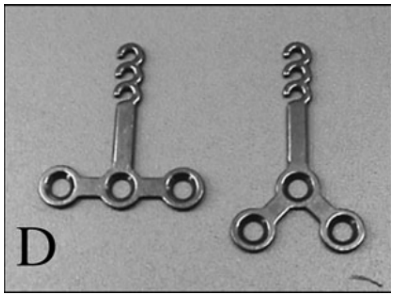

Figura 7 : *Skeletal anchorage system* (33)

- Sistema Bollard de Hugo De Clerck : las tres partes forman una única pieza lo que disminuye el riesgo de fractura.

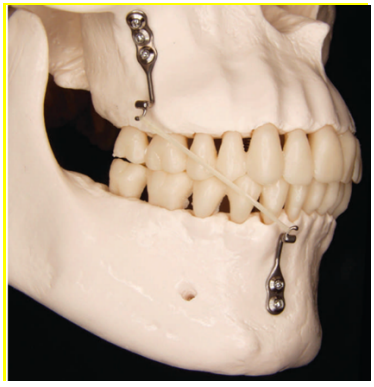

Figura 8 : dispositivos Bollard para realización de Bone Anchorage Maxillary Protraction (32)

- El tubo C : sirve de alternativa cuando el uso de los minitornillos u SAS y Bollard es imposible.

Las miniplacas generalmente de Titanio se colocan a nivel de la cresta infra cigomática y a nivel de la región canina mandibular. La placa se puede doblar para que se adapte a la superficie ósea con el fin de lograr un contacto firme con la superficie. Igualmente, la barra que emerge de la mucosa servirá de conexión entre la miniplaca y los aditamentos, tendrá que seguir el

reborde inferior de la placa y emerger de la mucosa para tener una buena cicatrización de los tejidos blandos.

Cornelis et al. califican el procedimiento de “sencillo y bastante rápido que típicamente se puede realizar bajo anestesia local sin complicaciones” y “seguro y efectivo para el tratamiento ortodóntico” (28). El uso de *cone-beam computed tomography* (CBCT) puede ser útil para situar los TSADs de forma idónea, sobre todo en pacientes infantiles.

Se pueden usar elásticos denominados de clase III para interrelacionar las miniplacas 24h/día (se mantienen incluso durante la comida). Igualmente con estos elásticos se podrán utilizar dispositivos tipo Bollard que permiten al odontólogo de variar el punto de aplicación de la fuerza y así variar este punto sobre el implante. Un levante de mordida puede ser usado para facilitar el movimiento.

D. Expansión rápida del paladar asistida por mini tornillos (22)

Se insertan bajo anestesia local 4 mini tornillos : 2 parasagitales a la sutura palatina de 2x9 mm y dos mandibulares localizados entre el canino y el incisivo lateral. Se colocan bandas en los primeros molares inferiores con el fin de crear un arco lingual modificado (MLA) con alambre de Romanium de 1mm y cementado con cemento de ionómero de vidrio (CIV) cuyos servirán de punto de anclaje para la posterior colocación de elásticos. En los incisivos inferiores el MLA se asegura con composite. Se diseña en el maxilar un *hybrid mini-implant-assisted rapid maxillary expander* (MARPE) con un tornillo de expansión (0,25mm por vuelta), se cementan las bandas con CIV en los primeros premolares y primeros molares superiores. Tras haber realizado la movilización del maxilar se tracciona entre otras posibilidades mediante el

uso de elásticos de clase III, se interrelacionan los *hooks* homolaterales maxilares y mandibulares. Cada elástico se cambia una vez al día y proporcionan una fuerza de 400gr. Un primer elástico *long-closing class III* se coloca desde el molar superior hasta el *hook* vestibular del MLA, un segundo *short-closing class III* se coloca de la parte anterior del anclaje premolar del MARPE híbrido hasta mismo *hook* que el *long-closing*. Se mantienen hasta obtener un resalte de ± 2mm.

Figura 9 : A. MARPE híbrido y B. MLA (22)

E. Dispositivo Hyrax híbrido / dispositivo Hyrax

Dispositivo HYRAX : es un dispositivo de acero inoxidable fijo que permite el desarrollo del maxilar, se ponen 4 bandas en los primeros molares superiores y primeros premolares superiores. Cerca de la sutura palatina se localiza un tornillo de expansión. Un refuerzo de la estructura se puede realizar añadiendo alambres en palatino y vestibular. La sutura se abre anteroposteriormente siendo la apertura anterior mayor que la posterior. Se suele utilizar en los protocolos de expansión rápida del maxilar (ERM). (10) El dispositivo se activa dos veces al día dando vuelta de ¼ durante 15 días y se mantiene fijo durante 6 meses en retención pasiva.

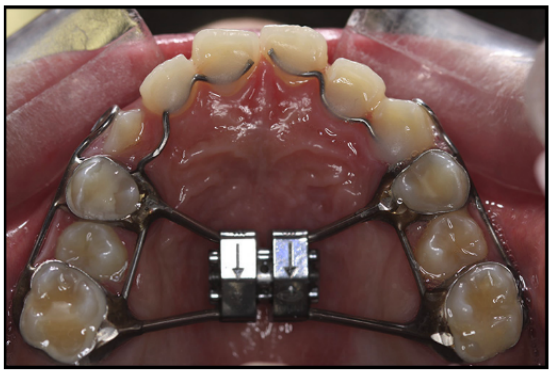

Figura 10 : Dispositivo HYRAX (34)

Transverse sagital maxillary expander (TSME) : este dispositivo de expansión suele presentar 2 tornillos de expansión transversal de 8mm (10) y dos extensiones de acero inoxidables en palatino de los incisivos superiores con dos otros tornillos de disyunción sagital localizados entre los premolares y los incisivos sobre las extensiones. El TSME permite un desarrollo anteroposterior y transversal del maxilar. El tornillo se activa de ¼ de vuelta dos veces al día durante 15 días y luego una vuelta cada 7 días durante 6 a 8 meses. Por último se deja inactivo como retención pasiva durante 4 meses. El TSME no suele aumentar la dimensión vertical anterior lo que es interesante en caso de pacientes con mordida abierta anterior. (10)

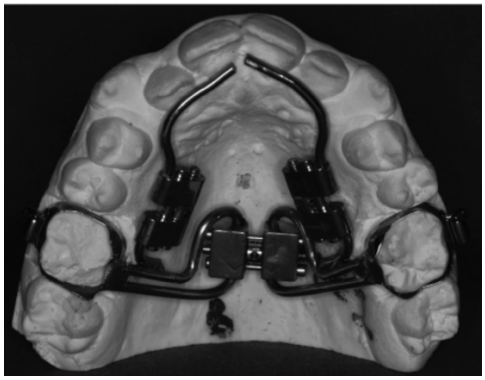

Figura 11 : TSME (10)

Dispositivo HYRAX híbrido : Se basa en la colocación de dos mini implantes de un lado y del otro de la sutura maxilar detrás de la papila interdental y dos bandas en los primeros molares superiores. La expansión maxilar rápida se realiza activando el tornillo de expansión de 90° cuatro veces al día lo que aumenta la amplitud del tornillo de 0,8mm. Su denominación "híbrido" se debe a su soporte a la vez óseo y dentario. (35)

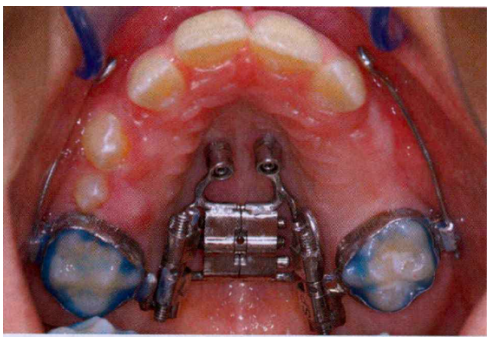

Figura 12 : dispositivo HYRAX *híbrido* (35)

F. Double hinged expanders

El *double hinged expanders* (DHE) de su denominación en ingles es un dispositivo de expansión maxilar que proporciona un mayor desplazamiento de dicho hueso que respecto a un dispositivo Hyrax por ejemplo. El DHE posee dos bisagras (en inglés, *hinge*) de rotación que permiten girar cada mitad del maxilar hacia fuera : sin embargo, no favorece la reabsorción de las tuberosidades retromaxilares. Su apoyo es dentario mediante bandas en los primeros molares y premolares superiores. Se activan los dos tornillos de expansión siguiendo el protocolo Alt-RAMEC. (36)

Figura 13 : Double hinged expanders (36)

G. *Alternating rapid maxillary expansion and constriction Protocol (Alt-RAMEC)*

El protocolo Alt-RAMEC que consiste en alternar fases de expansión y constricción ha sido desarrollado entre otro por Eric Jein-Wein Liou (34,36,37). El propósito de este protocolo es lograr una mayor expansión y protracción del maxilar, mediante la desarticulación de las suturas que con la aplicación del protocolo RME que consiste en una expansión rápida y el uso de una máscara facial. Con el protocolo RME (37) se puede ampliar transversalmente de 1,5-3mm en 10 a 12 meses el maxilar. Mientras con el protocolo Alt-RAMEC se amplía el maxilar de 5-6mm en 5 meses. Esta discrepancia entre los dos protocolos se debe a la capacidad del Alt-RAMEC de proveer una mayor apertura de las suturas perimaxilares lo que permite lograr una mayor protracción y expansión. Sin embargo, Wang et al. (37) han concluido que, para lograr la apertura de las suturas circundantes hacían falta más de 5 semanas de tratamiento. Este protocolo Alt-RAMEC está indicado para el tratamiento de las clases III leves a moderadas.

El protocolo Alt-RAMEC se puede utilizar con HYRAX, mini implantes híbridos de expansión maxilar (MARPE) o bien con *double hinged expanders*.

En un estudio clínico randomizado (34) se detalló el protocolo Alt-RAMEC con un dispositivo HYRAX. Se posicionan bandas en los primeros molares maxilar y primeros premolares o primeros molares temporales si no están erupcionados y se posiciona el dispositivo HYRAX. Se sitúan los *hooks* de protracción a nivel de los caninos maxilares. Se activa el HYRAX cuatro veces al día para un total diario de 1 mm (0,25mm x 4 – dos por la maña y dos por la noche -) luego se cierra el tornillo de distracción de 1mm/día durante una semana y la semana siguiente se repite el esquema de apertura de 1mm/día durante 7 días. Estas semanas alternadas de compresión y distracción se van a ir alternando durante 7 a 9 semanas. El principio del Alt-RAMEC se basa en la desarticulación de las suturas.

La desarticulación se comprueba de forma manual y subjetiva por el profesional : se coloca una mano en la frente y la nariz y con la otra se sujetan los incisivos superiores. Así el odontólogo valora la movilidad del maxilar, si está suficiente pasamos a la siguiente etapa que es de protracción. (22)

En total son 7 a 9 semanas de Alt-RAMEC para movilizar el maxilar, 1 a 2 meses de tracción maxilar y 2 a 3 meses de estabilización manteniendo la protracción maxilar sin añadir fuerzas de más. (36)

H. Frankel III (12)

Este aparato presenta escudos acrílicos vestibulares bilaterales para alejar el músculo buccinador y disminuir su acción restrictiva sobre el crecimiento del maxilar. Además presenta

almohadillas labiales superiores de acrílico para disminuir la fuerza ejercida por los músculos respecto al crecimiento anteroposterior del maxilar. Las almohadillas permiten también retruir la posición de los dientes superiores y estimular el desarrollo alveolar maxilar mediante la ausencia de contacto entre las arcadas antagonistas. Los diversos elementos de acrílico están vinculados entre ellos por alambres. El Frankel III se activa alejando las partes acrílicas de 3 mm de los procesos alveolares. Tiene como ventaja de actuar sobre el maxilar sin incidir sobre la mandíbula, sin embargo, se aconseja en clase III muy leve. Sobre todo sirven actualmente como dispositivos de retención.

II. Aparatos de ortodoncia (38)

En conjunto con los aparatos de ortopedia se pueden utilizar dispositivos ortodóncicos para corregir el posicionamiento de los dientes solo. Dentro de los diferentes aparatos disponibles existen dispositivos fijos y removibles. Dentro del conjunto de los aparatos disponibles detallaremos los que se utilizan con mayor frecuencia en pacientes de clase III de origen maxilar. Los aparatos removibles permiten en mayor medida lograr un efecto ortodóncico siendo las fuerzas aplicadas demasiadas leves para tener un efecto movilizador en las estructuras óseas.

A. Dispositivos removibles

a) *Planos inclinados (6,17)*

Este tratamiento se suele dirigir a clases III en dentición mixta o decidual con las siguientes características :

- Incisivos maxilares retroinclinados
- Ausencia de proinclinación de los incisivos inferiores

- Sobre mordida profunda o normal : exclusión de los pacientes con mordida abierta (MA)
- Patrón de crecimiento convergente

El plano inclinado está situado en los incisivos inferiores, la angulación viene determinada por la relación de los dientes en mordida cruzada anterior (MCA) con los adyacentes. La mayoría de los dientes en MCA pueden ser corregidos en 3 a 4 semanas. Sin embargo, empeora la inclinación previa de los incisivos inferiores si previamente existía una tendencia.

b) *Planos inclinados modificados (6)*

Este dispositivo tiene la ventaja de no tener repercusiones en los incisivos inferiores. Tiene un diseño similar a una placa de Hawley combinada con un plano inclinado. El plano cubre los incisivos inferiores hasta el tercio incisal y cuando el paciente muerde favorece la proinclinación superior. Está colocado mediante el uso de ganchos de Adams en los primeros molares permanentes y un arco labial inferior a altura del tercio cervical (± al nivel del centro de resistencia). La placa de acrílico se puede ajustar para permitir la linguloversión de los incisivos inferiores si se decide activar el arco lingual. La corrección de la MCA tarda 3-4 semanas en corregirse (dependiendo obviamente de su grado) y se podrá utilizar el dispositivo de forma inactiva como retenedor.

c) *Placa de Hawley (6)*

Se indica para pacientes en dentición mixta, tiene un componente anterior tipo tornillo o resortes que favorece la proinclinación superior. La retención se logra mediante el uso de ganchos

Adams en los primeros molares permanentes. Se puede aumentar el resalte hasta 2mm en 5 a 6 semanas. Se pueden añadir levantes de mordida en caso de sobre mordida profunda anterior.

B. Dispositivos fijos

a) *Brackets tipo "2 by 4" o "2 by 6" (6)*

Con este dispositivo solo se cementan los dos primeros molares maxilares y los incisivos superiores y eventualmente los caninos, es un dispositivo que se suele utilizar fuera del periodo óptimo de movilización de las suturas. Un resorte de NiTi se usa para favorecer la proinclinación o un arco de acero inoxidable para ampliar la longitud de arcada. Se puede crear un levante de mordida posterior temporal mediante el uso de cemento de ionomero de vidrio en oclusal. La ventaja de este dispositivo es que genera menos molestia fonética para el paciente, además tiene una ventaja económica al ser menos caro respecto a los dispositivos removibles. Sin embargo, la adaptación inicial al dispositivo es más larga que con los removibles.

Objetivos

1. Analizar las opciones de tratamiento en caso de maloclusiones de clase III de origen maxilar en pacientes en crecimiento.
2. Determinar la edad idónea para tratar las clases III de origen maxilar.
3. Investigar las nuevas tendencia de tratamiento de clase III maxilar en pacientes en crecimiento.
4. Determinar los tratamientos de clase III maxilar que presentan la mejora tasa de éxito y la menor recidiva en pacientes en crecimiento.
5. Observar los límites de los tratamientos disponibles.

Material y métodos

Se realizó una búsqueda bibliográfica en las bases de datos *Medline* y *Pubmed* limitándose a los 15 últimos años y ampliando hasta los 20 años o más en caso de artículos o libros insustituibles o especialmente relevantes. Los idiomas utilizados fueron el castellano, ingles y francés. Las palabras claves en una primera intención fueron *class III, treatment appliances, maloclusion, biotype, caracteristics, children* y luego dependiendo de las dianas la búsqueda ha sido especificada con las palabras siguientes *maxilar, protraction, Hyrax, Alt-RAMEC, ortopedics, outcome.* La búsqueda ha sido orientada hacia las clases III de origen maxilar y un especial enfoque ha sido dado a los nuevos protocolos y tratamientos.

Han sido incluidos los artículos enfocando el tratamiento en el maxilar en pacientes en crecimiento. Se incluyeron también artículos tratando de nuevos protocolos de tratamiento de las maloclusiones que nos interesan. Se envolvieron los artículos con un seguimiento del tratamiento tras haber sido retirado (sin embargo, no se trata de un criterio de inclusión fundamental). El criterio de inclusión ha sido la fecha de publicación que tenía que ser reciente (salvo que la información encontrada en más antiguos no tenga equivalente) y el objetivo ha sido de utilizar principalmente como fuentes artículos que han sido publicados en revistas de impacto tal como el *American journal dentofacial orthopedic* o *Journal of oral and maxilofacial surgery* entre otros. Fueron descartados los artículos tratando exclusivamente de pacientes sin crecimiento, los artículos tratando de cirugía ortognática y/o exclusivamente de ortodoncia. Tampoco se incluyeron los artículos cuyo tema principal era la clase III de origen mandibular. Igualmente han sido excluidos los artículos cuyos resultados no podían ser

interpretados o que tenían un sesgo en la realización o interpretación de los resultados. Se excluyeron los artículos tratando de maloclusiones que no sean de clase III.

Los criterios de inclusión y exclusión están resumidos en la tabla 1.

Inclusión	Exclusión
- Clase III maxilar - Seguimiento de tratamiento - Publicación reciente - Revistas de impacto - Crecimiento	- Ausencia de crecimiento maxilar - Cirugía ortognática / ortodoncia solo - Clase III asociado a síndrome - Clase III mandibular - Sesgos de interpretación o realización - Clase II - Clase I

Tabla 1 – Criterios de inclusión y exclusión

Resultados

De los 150 resultados encontrados en *pubmed* y 15 resultados de *medline complete*, han sido seleccionados para redactar este trabajo 38 referencias bibliografías. De estas referencias seleccionadas han también sido utilizados libros. De los artículos seleccionados para contestar a los objetivos 17 de ellos permiten comparar los resultados de las diferentes investigaciones de las opciones de tratamientos. Dichos resultados son presentados a continuación en un cuadro que especifica el artículo, el dispositivo empleado con el protocolo utilizado y los resultados logrados.

Autores	*Títulos*	*Dispositivos utilizados*	*Duración*	*Resultados*
Nienkemper et al. (27)	*Maxillary protraction using a hybrid Hyrax-facemask combination.*	• Hyrax híbrido • Máscara facial Delaire y elásticos (angulación 20-30°)	5,8 ± 1,7 meses	• No movimiento dental indeseado por anclaje óseo. • ANB : +3,2° • Wits : +4,1mm • Resalte : +2,7mm • No cambio en la relación 1.1 • No variación dimensión vertical (DV) • Mesialización primeros molares superiores +0,4mm
Farronato et al. (10)	*Rapid maxillary expansión in growing patients. Hyrax VS TSME : a cefalometric investigation.*	• TSME • Hyrax	TSME : 6 a 12 meses RME : 6 a 7 meses	TSME : • ANB no aumento significativo • Aumento perímetro del maxilar • Resalte : positivo (por mesialización de los procesos alveolares) • Paciente con crecimiento vertical RME : • Aumento DV anterior • Extrusión molares superiores • Aumento tamaño del maxilar inferior respecto TSME

Wiedel et al. (38)	*Fixed VS removible orthodontic appliances to correct anterior crossbite in the mixed dentition – a randomized controlled trial.*	• Placa de Hawley con dos resortes de protrusión retroincisivales, levantes de mordida posteriores y tornillo de expansión • 8 brackets de acero inoxidable (de 5 a 5 maxilar) y composite oclusal en dientes posteriores Secuencia de hilo recto : 0,16mm Niquel titanio termoactivado (HANT), 0,19 x 0,25 HANT y 0,19 x 0,25 acero inoxidable	Evaluación cada 4 semanas y retención con los propios dispositivos inactivos durante 3 meses Duración media incluyendo la retención : • Hawley : 6,9 meses • Brackets : 5,5 meses	<u>Removible y fijo :</u> • Aumento sobremordida • Aumento recorrido total de la arcada maxilar o transversal • Aumento proinclinación incisivos superiores <u>Fijo :</u> • Mayor aumento resalte respecto a removible (P<0,05) • Mayor aumento longitud arcada incisal y gingival respecto a removible (P < 0,01)
Woon et al. (21)	*Early orthodontic treatment for class III malocclusion : a systematic review and meta-analysis*	• Máscara facial y placa de expansión • Máscara facial sin expansión • Mentonera con levantes de mordida (300 g) • Tracción con arco facial	• Estudio de Mandall et al. : 15 meses y 3 años • Demás estudios : seguimiento a corto plazo	• Corrección resalte y según Mandall et al. mantenimiento a +3,6mm • <u>Máscara facial :</u> - aumento ANB de 2° a 5° - aumento SNA y SNB • <u>Mentonera :</u> - 0,3° a 2,5°ANB - Poco eficacia de restricción de SNB

Wilmes et al. (35)	*The hybrid Hyrax distalizer, a new all-in-one appliance for REM, early class III tratment and upper molar distalization*	• Máscara facial de protracción 400g + distalización molares superiores con *Hybrid Hyrax* (mini implantes palatinos)	• 6 meses protracción • 14 meses máscara inactiva + distalización	• SNA aumento de 4,6° • No cambios significativos SNB • Wits : aumento de 6,9mm (de -5,2 hasta 1,7mm) • Aumento longitud arcada
Almuzian et al. (39)	*The effectiveness of Alt-RAMEC combinated with maxillary protraction in the treatment of patients with a class III malocclusion : a systematic review and meta-analysis*	• Máscara de protracción + hyrax (bandas) (350 hasta 600g dependiendo de los estudios) con dos protocolos de expansión - Alt-RAMEC - RME	• Protocolo Alt-RAMEC : 10,95 ± 2,73 • Protocolo RME : 11,19 ± 2,75	• No cambios inclinación incisivos inferiores • No cambios significativos proinclinación incisivos superiores • Mayor resultados para el grupo Alt-RAMEC - ANB - SNA - SNB disminuido
De Clerck et al. (32)	*Success rate of miniplate anchorage for bone anchorage maxillary protraction*	• BAMP con elásticos 150g	• 12 meses	• Inestabilidad de 5 miniplacas Bollard de los 25 pacientes • Estabilidad 97% • Desaconsejado antes de los 11 años por la calidad del hueso

Cevidanesa et al. (40)	*Comparison of two protocols for maxillary protraction : bone anchors (BAMP) versus face mask with RME*	• BAMP con elásticos 20-23, 150 g hasta 300g tras 3 meses. • Máscara facial + expansión + elásticos gruesos y RME, 300g hasta 500g/lado.	• Reevaluación tras 12 meses para ambos protocolos.	• Mayor aumento Co-A en BAMP • Aumento Wits similar • Disminución discrepancia maxilomandibular de 2,3mm • BAMP : - Buen control crecimiento tercio facial inferior, cierre ángulo goniaco aunque mayor crecimiento vertical respecto a REM.
Baccetti et al. (16)	*Skeletal effects of early treatment of class III malocclusion with maxillary expansión and face-mask therapy*	• Máscara facial (Petit), elásticos y expansión con placa acrílica.		<u>Tratamiento precoz :</u> • Desplazamiento anterior del maxilar • Control del crecimiento mandibular y de la protrusión. • Aumento del crecimiento Co-A (tercio medio) • Menor angulación y crecimiento del cóndilo (crecimiento hacia detrás y arriba) <u>Tratamiento tardío :</u> • No cambios significativos a nivel óseo • Cambios dentoalveolares

				• No cambios significativos de la angulación del cóndilo.
Bardellini et al. (13)	*Long terme evaluation of the efficacy on the podalic suppport and postural control of a new elastic funcional orthopaedic device for the correction of class III malocclusion*	• *Mouth slow balance*	• 7 años	• Corrección del valgus plantar • Disminución significativa de la discrepancia del soporte podálico entre los pies (discrepancia inicial > 15%, discrepancia final 0,2%) • Corrección exitosa de la maloclusión de clase III • Corrección favorable de la postura
Liu et al. (34)	*Effect of maxillary protraction with alt RAMEC VS expansión alone in maxillary retrusive patients: a single-center, randomized controlled trial*	• Hyrax y máscara facial (inclinación de 15 hasta 30°, 500g por lado). Máscara facial 14 horas al día mínimo.	• RPE : 11,19 ± 2,75 meses (mayor tiempo de protracción) • Alt RAMEC : 10,95 ± 2,73 meses	<u>Alt RAMEC :</u> • Mayor adelantamiento del maxilar • Mayor rotación antihoraria del paladar <u>REM :</u> • Mayor cambios óseos y tejidos blandos a nivel mandibular • Mayor rotación mandibular abajo y atrás No cambios significativos interdentales y intermaxilares entre los dos protocolos.

Wang et al. (37)	*Opening of circumaxillary sutures by alt RAMEC*	Comparación protocolos Alt RAMEC y RME.		<u>Alt RAMEC</u> • Protracción maxilar : 5-6 mm en 5 meses • Apertura de las suturas sagitales y circummaxilares más efectiva en menos tiempo <u>RME + máscara :</u> • Protracción maxilar : 1,5-3mm en 10 – 12 meses
Keles et al. (26)	*Effect of varying the force direction on maxillary orthopedic protraction*	• Máscara facial convencional : 500G, angulación 30° respecto al plano oclusal • Máscara facial modificada : 500G, angulación paralela al plano de Frankfort.	• 10 días RME, 6 meses máscara (16 horas al día mínimo los primeros 3 meses y 12h mínimo los 3 siguientes)	<u>Convencional :</u> • Rotación antihoraria del maxilar (rotación + translación) • No rotación dentición maxilar <u>Modificada :</u> • No rotación del maxilar, translación pura • Rotación horaria dientes maxilares con retroinclinación • Mayor extrusión incisivos superiores (6mm respecto a 1 mm en el grupo convencional) • Indicado en retrognatismo maxilar y tendencia a la mordida abierta.

Castrillon-Marin et al. (41)	*Treatment of class III malocclusion using hybrid hyrax, face mask and Alt RAMEC protocol: A case report in a Latin-American patient.*	• Hyrax híbrido (anclaje óseo), máscara facial	• Protocolo Alt-RAMEC (9 semanas) + máscara facial (10 meses)	• Rotación antihoraria de 5° del paladar • Ausencia de vestibulización de incisivos superiores / retroinclinación inferior gracias al anclaje óseo • Rotación horaria mandíbula • SNA +4° • Wits +3mm • ANB 0° inicial a +4° • Mayor adelantamiento con anclaje óseo, mejora de la trayectoria eruptiva de los caninos gracias al anclaje óseo • Aumento tercio medio, mejora soporte tejidos blandos.
Al-Mozany et al.(22)	*A novel method for treatment of class III malocclusion in growing patients*	• Elásticos de clase III (400g/lado), protocolo Alt RAMEC, MARPE.		• Proinclinación incisivos superiores y retroinclinación incisivos inferiores disminuida respecto a un enfoque tradicional • Disminución del perfil cóncavo (ANB) • Wits 5,16 • Mayor protracción maxilar gracias al protocolo Alt RAMEC ± elásticos clase III

				• Mejora posicionamiento anteroposterior de la mandíbula (rotación posterior) • Aumento tercio facial inferior, pero ni modificación significativa del medio. • Mejora resalte y sobremordida
D'Apuzzo et al. (42)	*Pediatric orthodontics part 4: SEC III protocol in class III malocclusion*	• Férulas bimaxilares oclusales de acrílico con elásticos de clase III – 250 hasta 500G/lado, mínimo 16h/día - (SEC protocolo modificado) y mentonera (400/800G por lado, mínimo 14h/día)	• Protocolo SEC ± 1 año (dependiendo de variables individuales)	• Control vertical (valido en patrón dolicofacial) • Extrusión molares superiores y rotación horaria mandibular compensada por la mentonera, no rotación horaria con la mentonera.

Discusión

El éxito de los tratamientos aplicados en pacientes con maloclusión de clase III depende de varios parámetros. Estas clases hacen parte de las más difíciles en tratar por el importante patrón genético que poseen.

Además, como ha sido desarrollado en los diferentes apartados, estos tratamientos requieren por la mayoría una participación del paciente : en la colocación de los dispositivos extraorales, en la activación de tornillos o colocación de los elásticos. Estas opciones tienen que ser elegidas según el tipo de maloclusión al cual nos enfrentamos, según las características de crecimiento del paciente (tendencia a hipo o hiperdivergencia de los planos) y también según la implicación que vamos a lograr del paciente / de la familia.

Existen varios protocolos en cuanto a la forma de actuar ; respecto a la movilización de las suturas circumaxilares y palatinas según los estudios de Wang et al. (37) el protocolo *Alt RAMEC* permite lograr una apertura más rápida y en menos tiempo que con un protocolo REM. Sin embargo, este estudio siendo realizado sobre animales requiere un apoyo adicional cuyo puede ser proporcionado por el estudio de Liu et al. (34) donde notamos un acortamiento del periodo de tratamiento y una mejor recolocación espacial del maxilar. En efecto, en este estudio (34) el protocolo *Alt RAMEC* ha permitido un adelantamiento del punto A 1,4 más lejo respecto al protocolo *REM*. Igualmente, según este mismo estudio el protocolo *Alt RAMEC* permite una mayor movilización del paladar lo que disminuye la probabilidad de inducir errores a la hora de traccionarlo. En efecto, la tracción mediante un apoyo extraoral presenta dependiendo de los dispositivos efectos indeseables.

Como referido en el estudio de Al-Mozany et al. (22), el enfoque tradicional con máscara y aplicación de la fuerza sin variación y con una angulación presentan como

consecuencia una rotación y translación del maxilar además de una proinclinación de los incisivos superiores. Dependiendo de las zonas de apoyo y/o si se emplea una mentonera observaremos también una retroinclinación de los incisivos inferiores. En pacientes de clase III podemos observar o no una compensación dentaria de la discrepancia intermaxilar : en caso de compensación importante el componente dentario puede verse empeorado mientras se está movilizando el componente óseo. Con el fin de tener un mejor control se han desarrollado protocolos y técnicas tal como el protocolo de Al Mozany et al. (22) cuyo mediante el uso de elásticos de clase III y anclajes óseos permite un mejor control de los dientes mientras se está realizando la tracción. Igualmente, en el enfoque tradicional los anclajes suelen ser dentales lo que tiene como consecuencias indeseables entre otras : extrusión de molares, anquilosis de los caninos. La rotación horaria del maxilar debida a la tracción extraoral con una angulación puede ser minimizada (26) ejerciendo una fuerza paralela al plano de Frankfort : sin embargo, la translación pura ocasionará una rotación horaria de la dentadura maxilar. Entonces, este tipo de tracción a pesar de presentar la ventaja de abstenerse de rotar el maxilar no se puede indicar en paciente con sobremordida profunda o con un patrón de crecimiento a tendencia dolica. Para el crecimiento de patrón divergente los elásticos de clase III como los presentados en el protocolo SEC modificado (42) presentan una buena alternativa a la hora de proporcionar un mayor control vertical de la recolocación del maxilar. Empero, este estudio de D'Appuzo et al. (42) no proporciona retrocontrol de las recidivas asociadas al empleo de este protocolo. Hoy en día se está investigando en los mini tornillos (TSADs) con el fin de proporcionar un anclaje óseo para realizar la ortopedia, en efecto presentan varias ventajas que entre otro permiten evitar la anquilosis de los dientes. No obstante, pueden causar alteraciones en las raíces de los dientes dependiendo de la zona donde se colocan. En efecto pueden ser colocados en zona bucal para servir de anclaje para traccionar el maxilar o bien en zona palatal para servir de apoyo al

disyunctor. Proporcionan una estabilidad de hasta 97% pero por ser de anclaje oseo directo retrasan la edad de tratamiento hasta los 11 años para que la calidad ósea (densidad etc.) este suficiente poniendo nos levemente fuera de la edad idónea, a saber en torno a los 7 años. En el protocolo BAMP sin embargo, ha sido puesto en luz un mayor crecimiento vertical respecto a un protocolo REM.

En cuanto a la estabilidad a largo plazo de los tratamientos de clase III De Toffol (14) propone una revisión de 6 artículos dando información notable mediante el uso de cefalometría. En los tratamientos tardíos las recaídas afectan sobre todo a la región maxilar. Destacarán en la revisión que tras 2 años los grupos que sean control o tratado no presentan diferencias significativa lo que permite decir que el tratamiento es bastante estable. No obstante, sí que se observó una disminución del resalte que se debe a la retroinclinación incisiva y en ciertos pacientes a un rebote del crecimiento mandibular. Por lo tanto los pacientes tratados mediante dispositivos ortodóncicos y ortopédicos requieren una sobre corrección al finalizar el periodo de tratamiento (paciente llevado en clase I a tendencia de clase II e incluso en determinados casos directamente a una clase II). Este estudio también permitió detallar que en sujetos con una forma de restricción mandibular (mentonera por ejemplo) la estabilidad del resalte está mayor. Entonces, una corrección importante mediante el uso de métodos ortopédicos es imprescindible a la hora de mantener de forma estable los resultados logrados.

Wiedel et al. (38) concluyó que dependiendo del tipo de maloclusión en corregir se podía preferir el uso de dispositivos fijos : en efecto los dispositivos fijos permiten un mayor aumento del resalte y de la longitud de arcada (dentaria y gingival).

Comparar estudios entre ellos es bastante complejo debido a la falta de homogeneización en la forma de leer las cefalometrías. Igualmente, el patrón facial por ser por

mucho influenciado por condiciones genéticas, un mismo tratamiento, a pesar de ser exitoso en la mayoría de los casos, podrá revelarse irrelevante en ciertos pacientes. Desde ahí, la importancia de una buena historia clínica para anticipar a largo plazo las dificultades que podrán surgir y también se podrán realizar simulaciones de crecimiento óseo con el fin de proveer la dificultad del tratamiento. Además, en los diversos estudios enunciados a lo largo de este trabajo los tiempos de tratamiento suelen variar bastante lo que dificulta la comparación por falta de correlación temporal. A pesar de estas, ha sido concluido de los varios estudios un éxito hasta más de 75% de los tratamientos esqueléticos precoces – al torno de los 6/8 años - de clase III a los 5 años post tratamiento (Masucci et al. (43) hace referencia de 73% de éxito tras tratamiento con disyuntor y máscara facial.)

Establecer una jerarquía de éxito de los diferentes dispositivos es muy complejo por las razones previamente enunciadas. Sin embargo, sí que el protocolo Alt RAMEC da mejores resultados de movilización maxilares (5 a 6 mm en 5 meses) igualmente los anclajes óseos están en investigar por las ventajas antedichas que presentan. Las modificaciones de los diversos protocolos existentes como la angulación de la tracción no influyen en el resultado global, sino en detalles. En efecto, van a permitir adaptar el tratamiento a las características individuales del paciente (tendencia a crecimiento vertical, necesidad de mayor resalte etc.) para mejorar el resultado final.

Más allá de la dificultad de homogeneización de los resultados en los diversos estudios explicitados se carece de información en cuanto a los resultados a largo plazo de los tejidos blandos. A pesar de esto, un estudio ha evaluado los efectos sobre la postura y ha permitido destacar una corrección de la discrepancia bípeda llevándola a un 0,2%, entonces la interrelación de las diversas estructuras del cuerpo es interesante en valorar a la hora de construir el protocolo individualizado del tratamiento del paciente. Sería conveniente la

realización de estudios homogeneizados en cuanto a la interpretación cefalométrica y los tiempos de tratamientos con el fin de establecer una comparación en cuanto al éxito real entre las diversas ofertas de tratamiento y protocolos.

Conclusión

1. Las opciones de tratamiento a la hora de tratar los pacientes clase III maxilar son varias. La elegida tiene que tomar en cuenta las características individuales y cumplir los objetivos individuales de planificación. El diseño del tratamiento es totalmente individualizable lo que permite lograr resultados optímales para cada caso. Dependiendo de las necesidades de los pacientes se podrán combinar los tratamientos ortopédicos con tratamientos ortodóncicos. Sin embargo, esta individualización de los tratamientos dificulta la comparación entre diferentes casos.
2. La edad idónea es "cuanto antes posible", siendo al torno de los 7 años lo ideal.
3. Las nuevas tendencias actuales a saber el protocolo *Alt RAMEC* y el anclaje óseo con TSADs permiten disminuir la duración de los tratamientos y tener menos efectos secundarios a consecuencia de los tratamientos ortopédicos.
4. Los tratamientos que se asocian a mayor éxito y menor recidiva parecen ser los realizados mediante disyuntores Hyrax y la máscara facial. El tratamiento de la maloclusion mediante el anclaje óseo con minitornillos y miniplacas también presenta resultados exitosos y estables.
5. No obstante, los tratamientos actuales se enfrentan a dificultades en cuanto a la armonización de los protocolos y a la corrección de grandes discrepancias que actualmente solo se pueden solucionar mediante el uso de cirugía.

Responsabilidad

La responsabilidad social presenta un impacto que se puede clasificar en tres niveles.

El primer nivel es la sostenibilidad económica. Los protocolos de tratamiento de estas maloclusiones tienen como objetivo principal restaurar un equilibrio orofacial pero además tiene que cumplir objetivos económicos. El hecho de tratar de forma temprana no solo tiene una ventaja a la hora de hablar de porcentaje de éxito sino que también disminuye las futuras necesidades del paciente favoreciendo a largo plazo la sostenibilidad económica. La búsqueda continua de mejora de los protocolos tiene como objetivos entre otros la disminución de efectos indeseados y secundarios siempre con este objetivo de minimizar la necesidad de tratamiento secundarios y/o de dispositivos para evitar recidivas.

En segundo lugar encontramos la sostenibilidad medioambiental. La disminución del numero de dispositivos necesarios a la corrección de las maloclusiones además de ser pertinente de forma económica también permite reducir la cuantidad de material requerido para un solo paciente. En efecto estos dispositivos son de uso individual y requieren ser adaptados a medida que va creciendo el paciente y también a medida que vamos adelantándonos en el tratamiento.

Por último podemos hablar de la sostenibilidad social. Esta admitido que la sonrisa tiene un impacto fundamental en las relaciones con los demás y en la forma de percibirse. Una sonrisa y una harmonía oro facial facilitará la confianza en si y permitirá también mejorar las relaciones que sean personales o en el mundo laboral.

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Anexos

THE

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CENTENNIAL SPECIAL ARTICLE

100 Years AJO-DO

Evolution of Class III treatment in orthodontics


Peter Ngan[a] and Won Moon[b]
Morgantown, WVa, and Los Angeles, Calif

Angle, Tweed, and Moyers classified Class III malocclusions into 3 types: pseudo, dentoalveolar, and skeletal. Clinicians have been trying to identify the best timing to intercept a Class III malocclusion that develops as early as the deciduous dentition. With microimplants as skeletal anchorage, orthopedic growth modification became more effective, and it also increased the scope of camouflage orthodontic treatment for patients who were not eligible for orthognathic surgery. However, orthodontic treatment combined with orthognathic surgery remains the only option for patients with a severe skeletal Class III malocclusion or a craniofacial anomaly. Distraction osteogenesis can now be performed intraorally at an earlier age. The surgery-first approach can minimize the length of time that the malocclusion needs to worsen before orthognathic surgery. Finally, the use of computed tomography scans for 3-dimensional diagnosis and treatment planning together with advances in imaging technology can improve the accuracy of surgical movements and the esthetic outcomes for these patients. (Am J Orthod Dentofacial Orthop 2015;148:22-36)

In 1899, Angle[1] was the first to classify malocclusions into Class I, Class II, and Class III based on the relationship of the first molars and the alignment (or lack of it) of the teeth relative to the line of occlusion. Almost immediately, it was recognized that the Angle classification was not complete because it did not include important characteristics of the patient's problem. Gradually, Angle's classification numbers were extended to refer to the skeletal jaw relationship and the pattern of growth other than the molar relationship. Thus, a Class III jaw relationship meant that the mandible was positioned mesial to the maxilla. This was usually found in connection with a Class III molar relationship but occasionally could be a Class I molar relationship when the dental compensation overcame the skeletal imbalance. A Class III growth pattern is then defined as one with disproportionate forward mandibular growth or deficient maxillary growth.

[a]Professor and chair, Department of Orthodontics, School of Dentistry, West Virginia University, Morgantown, WVa.
[b]Associate clinical professor and program director, Section of Orthodontics, School of Dentistry, University of California, Los Angeles, Calif.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
Address correspondence to: Peter Ngan, Department of Orthodontics, West Virginia University, 1073 Health Science Center North, PO Box 9480, Morgantown, WV 26506; e-mail, pngan@hsc.wvu.edu.
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In 1966, Tweed[2] classified Class III malocclusions into 2 categories: category A was defined as a pseudo-Class III malocclusion with a conventionally shaped mandible, and category B was defined as a skeletal Class III malocclusion with a large mandible or an underdeveloped maxilla. Moyers[3] further classified malocclusions according to the cause of the problem: osseous, muscular, or dental in origin. Moyers emphasized the need to determine whether the mandible, on closure, is in centric relation or in a convenient "anterior" position for patients with neuromuscular or functional problems. Anterior repositioning generally results from a tooth contact relationship that forces the mandible in a forward position. Moyers suggested that a pseudo-Class III malocclusion is a positional malrelationship with an acquired neuromuscular reflex.

The prevalence of Angle Class III malocclusions varies greatly among and within populations, ranging from 0% to 26%.[4] Pseudo-Class III malocclusions are found primarily in the deciduous and mixed dentitions. Approximately 60% to 70% of anterior crossbites in the 8- to 12-year-old group were classified as pseudo-Class III malocclusions.[5] A study excluding children under 11 years old found that the populations from Southeast Asian countries (Chinese and Malaysian) showed the highest prevalence rate of 15.8%.[6-9] Middle Eastern nations had a mean prevalence rate of 10.2%.[10,11] European countries had a lower prevalence rate of 4.9%,[12,13] and the Indian population showed the lowest prevalence rate of 1.2%.[8,9,14] In white children,

Volume one

CLINICAL ORTHODONTICS

Charles H. Tweed, D.D.S.
Tucson, Arizona

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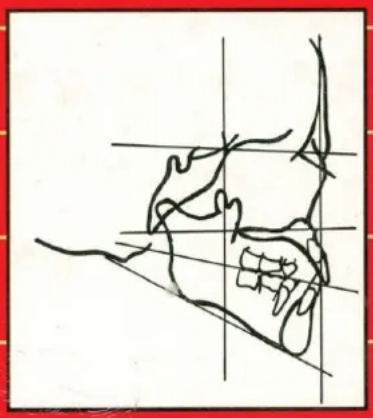
Saint Louis 1966

Moyers

Manual de ortodoncia



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Article original

Traitement précoce des malocclusions de classe III : les faits

Philippe AMAT*

19 place des Comtes du Maine, 72000 Le Mans, France

MOTS CLÉS :
Malocclusion de classe III /
Traitement orthopédique /
Traitement précoce /
Masque facial /
Revue systématique

RÉSUMÉ – L'objectif de cet article est d'exposer les faits probants publiés pour répondre aux questions suivantes : 1) Le traitement précoce des malocclusions de classe III est-il efficace ? 2) Quel dispositif thérapeutique est le plus efficace ? 3) Les résultats sont-ils stables ? Les convictions de Jean Delaire et de l'auteur quant à l'utilité d'une prise en charge habituellement précoce de ces dysmorphies seront exposées dans un second article [4].

KEYWORDS:
Class III malocclusion /
Orthopedic treatment /
Early treatment /
Facemask /
Systematic review

ABSTRACT – ***Early treatment for class III malocclusions: the facts.*** *The goal of this article is to present some evidence based facts in order to answer the following questions: 1) Is early treatment of class III malocclusions effective? 2) Which therapeutic device is the most effective? 3) Are the results lasting? The positions of Jean Delaire and the author regarding the usefulness of routine early treatment for these dysmorphia will be discussed in a second article [4].*

Recherche clinique

1. Introduction

Le traitement des malocclusions de classe III est réputé délicat, principalement en raison de leur schéma de croissance difficilement prévisible et potentiellement défavorable. Leur prise en charge soulève de nombreuses interrogations, dont celle du calendrier thérapeutique : quand faut-il traiter précocement et dans quelles circonstances est-il préférable de temporiser et d'attendre la fin de la croissance pour recourir à une chirurgie orthognatique ?

L'objectif de cet article est de présenter les faits probants publiés pour répondre aux questions :

- Le traitement précoce des malocclusions de classe III est-il efficace ?
- Quel dispositif thérapeutique est le plus efficace ?
- Les résultats sont-ils stables ?

Force est de constater que les données publiées sont loin d'être toutes aussi valides et incontestables qu'on pourrait idéalement l'espérer. Seul un nombre restreint de nos traitements repose sur des données incontestables et il nous faut gérer au mieux l'incertitude. Parfois, nous n'avons d'autre choix que d'utiliser, avec réserve et prudence, quelques rares études de qualité méthodologique inégale, notre expérience et/ou celle de nos confrères comme seules sources d'informations. C'est le vaste champ des convictions qui sont scientifiquement licites, dès lors qu'elles sont exposées en tant que telles. Un second article [4] présentera les concepts thérapeutiques qui sous-tendent ces convictions et leur mise en œuvre pour trois cas cliniques.

2. Rappels sur le syndrome de classe III

La définition proposée par Angle en 1899 [7], qui décrit la classe III par la protrusion de la mandibule et de l'arcade dentaire telle qu'observée au niveau des premières molaires, n'est qu'un symptôme commun aux classes III. Elle ne fournit pas d'indications diagnostiques ou thérapeutiques.

Les classes III peuvent être définies comme un syndrome [62], c'est-à-dire un ensemble de symptômes ou de signes constituant une individualité

* Auteur pour correspondance : amatph@noos.fr

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REVIEW

Developing Class III malocclusions: challenges and solutions

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Edlira Zere[1,*]
Prabhat Kumar Chaudhari[2,*]
Jitendra Sharan[3]
Kunaal Dhingra[4]
Nitesh Tiwari[5]

[1]Department of Orthodontic and Craniofacial Anomalies, School of Graduate Dentistry, Rambam Health Care Campus, Technion Faculty of Medicine, Haifa, Israel; [2]Division of Orthodontics and Dentofacial Deformities, Centre for Dental Education and Research, All India Institute of Medical Sciences, New Delhi, India; [3]Department of Dentistry, All India Institute of Medical Sciences, Bhubaneswar, India; [4]Division of Periodontics, Centre for Dental Education and Research, All India Institute of Medical Sciences, New Delhi, India; [5]Division of Pedodontics and Preventive Dentistry, Centre for Dental Education and Research, All India Institute of Medical Sciences, New Delhi, India

*These authors contributed equally to this work

Correspondence: Prabhat Kumar Chaudhari
Room No 406, 4th Floor, Division of Orthodontics and Dentofacial Deformities, Centre for Dental Education and Research, All India Institute of Medical Sciences, New Delhi 110029, India
Tel +91 837 504 4325
Email dr.prabhatkc@gmail.com

Abstract: Class III malocclusion represents a growth-related dentofacial deformity with mandibular prognathism in relation to the maxilla and/or cranial base. Its prevalence varies greatly among and within different races, ethnic groups, and geographic regions studied. Class III malocclusion has a multifactorial etiology, which is the expression of a moderate distortion of normal development as a result of interaction between innate factors or genetic hereditary with environmental factors. Various skeletal topographies of underlying Class III malocclusion are due to discrepancy in the maxillary and mandibular growth along with vertical and/or transverse problems apart from sagittal malformations. The spectrum of complications for Class III malocclusion ranges in gravity from dentoalveolar problems with functional anterior shift of the mandible to true skeletal problems with serious maxillomandibular discrepancies, which makes its diagnosis highly challenging in growing children. Concern regarding early treatment and the need for interceptive care in the case of Class III malocclusion has always been a dilemma, knowing that not all problems will be solved in these cases until maxillomandibular growth is further completed, and the long-term outcome of various treatment approaches may depend on the growth tendency of an individual. Interceptive treatment of Class III malocclusions should be undertaken if it prevents damage to the oral tissues and/or significantly reduces the amount or severity of future orthodontic and surgical interventions. This paper presents an overview of developing Class III malocclusion, with the emphasis on challenges and their solutions based on the best current available evidence.

Keywords: Class III malocclusion, facemask therapy, maxillary expansion, chin cup appliance, bone-anchored maxillary protraction, growth treatment response vector

Introduction

The father of modern orthodontics, Edward Hartley Angle, in 1899 classified malocclusions in Class I, Class II, and Class III based on permanent first maxillary and mandibular molars relationship and alignment (or lack of it) of teeth with reference to the line of occlusion.[1] Gradually, Angle's classification was modified and additional information such as jaw relationship and the pattern of growth were also included. Thus, a Class III jaw relationship suggests that the mandible has acquired a more mesial position in relation to the maxilla and/or cranial base.[2,3] Occasionally, due to dental compensation, sometimes there is Class I dental relationship on the Class III skeletal base.

Further, Charles Henry Tweed classified Class III malocclusions as a pseudo Class III malocclusion with normal mandible and underdevelopment of maxilla (category A) and skeletal Class III malocclusion with prognathic mandible or an underdevelopment of maxilla (category B).[4]

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Prevalence of angle class III malocclusion: A systematic review and meta-analysis

Daniel K. Hardy, Yltze P. Cubas, Maria F. Orellana*

Department of Orofacial Sciences, Division of Orthodontics, School of Dentistry, University of California, San Francisco, USA
Email: *OrellanaM@dentistry.ucsf.edu

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ABSTRACT

Objective: This study seeks to review current and relevant literature on global Angle class III malocclusion prevalence. Materials and Methods: The electronic databases PubMed, ISI Web of Knowledge, and the Cochrane Database of Systematic Review were searched using specific inclusion criteria to obtain applicable articles. All pertinent references were also examined for acceptability. Results: A total of 20 articles were identified using the inclusion criteria. The prevalence of Angle class III malocclusion ranged from 0% to 26.7% in different populations reported in the literature examined. Meta-regression analysis showed no statistically significant association between prevalence rates and the method of assessment, age group and year of the study. However, much of the study-to-study variation (approximately 40%) could be explained by population. Conclusion: These results suggest that the prevalence of Angle class III malocclusion varies greatly within different races and geographic regions. Chinese and Malaysian populations have a higher prevalence of Angle class III malocclusion compared to other racial groups, while Indian populations have a lower prevalence than all other racial groups examined.

Keywords: Malocclusion; Class III; Prevalence; Systematic Review; Meta-Analysis

1. INTRODUCTION

The Angle classification has prevailed over the last century as a simple, quantifiable method to test malocclusion prevalence within populations. However, what Angle defined as a "normal occlusion" should, in fact, be considered the "ideal" occlusion given the strict criteria he used in his classification. This ideal occlusion is rather uncommon and has driven researchers to disagree on how much deviation from the ideal should be accepted as normal [1].

According to the Angle classification, class III malocclusion is defined as the lower molar mesially positioned relative to the upper molar with no specifications in regards to the line of occlusion [1,2]. Nevertheless, as with all Angle's classification of malocclusion, class III malocclusion comprises several skeletal and dental components that may differ from the concept of normality. For example, it can be characterized by presenting a mandibular skeletal protrusion (mandibular prognathism), a maxillary skeletal retrusion, a combination of both, or no anteroposterior skeletal imbalances [3].

Multiple studies have documented the prevalence of Angle class III malocclusion. However, there seems to be a wide range of prevalence rates reported, usually attributed to variation among samples [4-38]. For example, several studies have indicated that Asian races have a higher prevalence of Angle class III malocclusion than other races [4-10]. In some instances population data have shown conflicting reports, such as differing studies among Nigerian children reporting Angle class III malocclusion prevalence ranging from 1.2% (1993) up to 11.8% (2004) [11-13].

In spite of the continually increasing data on malocclusion prevalence, little has been done to consolidate this information in a comprehensive and critical way [14]. Further; to the best of our knowledge, there has not been a systematic analysis of the prevalence of Angle class III malocclusion among different populations. Meta-analysis is a systematic method that uses statistical techniques for combining results from different studies to obtain a quantitative estimate of the overall effect of a particular intervention or variable on a defined outcome; meta-analysis produces a stronger conclusion than can be provided by any individual study. Although no protocol has been enacted governing the methods of Angle class III malocclusion prevalence studies, a review and meta-analysis of the available literature will be helpful in establishing guidelines for future researchers.

*Corresponding author.

Original Article

An Estimate of Craniofacial Growth in Class III Malocclusion

Brian C. Reyes[a,b]; Tiziano Baccetti[c,d]; James A. McNamara Jr[e,f,g]

ABSTRACT

Objective: To provide an estimate of growth in Class III malocclusion by means of the analysis of a large population of males and females.

Materials and Methods: The examined sample consisted of pretreatment lateral cephalometric records of 949 (492 females and 457 males) untreated Class III patients of Caucasian ancestry. Cephalometric dentoskeletal measurements at subsequent age periods in Class III subjects were compared with the population values from subjects included in the University of Michigan Growth Study (UMGS) at 11 consecutive age periods (from 6 through 16 years of age), in male and female groups separately.

Results: No difference was found between the Class III and normal groups for the sagittal position of the maxilla at any of the age intervals examined. Sagittal mandibular position and dimensions in Class III subjects were consistently larger than in normal subjects, with the interval of largest "increase" in mandibular length occurring on average 1 year later in both female and male Class III subject with respect to subjects with normal occlusion.

Conclusions: Increases in mandibular length were substantially larger in Class III subjects than in subjects with normal occlusion even during the more mature age interval (15 to 16 years). Lower anterior facial height was significantly larger in Class III individuals during the late developmental stages. (*Angle Orthod* 2006;76:577–584.)

KEY WORDS: Class III malocclusion; Mandibular growth; Sagittal skeletal characteristics

INTRODUCTION

Information on growth in different types of malocclusions and dentoskeletal disharmonies is vital to plan orthodontic treatment properly, anticipate growth trends in patients with the same type of disharmony, and refer to adequate control data when evaluating treatment outcomes. Admittedly, the best method for studying facial growth and development is through the analysis of longitudinal data. The large North American growth studies have provided longitudinal data for untreated individuals with different types of malocclusion.[1–4] These samples consist, however, primarily of individuals categorized as having either normal occlusion or Class I or Class II malocclusions.

Longitudinal studies with sample sizes adequate to describe Class III craniofacial growth are available only for individuals of Asian ancestry.[5,6] No major investigations of untreated Class III malocclusion in populations of Caucasian ancestry have been performed. There are two main reasons for this deficiency in the literature: the relatively low prevalence of Class III malocclusion (especially in Caucasian populations) and the well recognized need for intervention both by the public and the dental professionals.

In 1986, Guyer et al[7] attempted to characterize Class III individuals at different developmental stages by studying lateral cephalograms of 144 Class III chil-

[a] Resident, Orthodontic Graduate Program, University of Michigan, Ann Arbor, Mich.

[b] Private practice, Orthodontics, Rochester Hills, Mich.

[c] Assistant Professor, Department of Orthodontics, The University of Florence, Florence, Italy.

[d] Thomas M. Graber Visiting Scholar, Department of Orthodontics and Pediatric Dentistry, School of Dentistry, The University of Michigan, Ann Arbor, Mich.

[e] Thomas M. and Doris Graber Endowed Professor of Dentistry, Department of Orthodontics and Pediatric Dentistry, School of Dentistry, The University of Michigan, Ann Arbor, Mich.

[f] Professor of Cell and Developmental Biology, School of Medicine, The University of Michigan, Ann Arbor, Mich.

[g] Research Scientist, Center for Human Growth and Development, The University of Michigan, Ann Arbor, Mich.

Corresponding author: Tiziano Baccetti, DDS, PhD, Università degli Studi di Firenze, Via del Ponte di Mezzo, 46-48, 50127 Firenze, Italy (e-mail: tbacc@tiscali.it)

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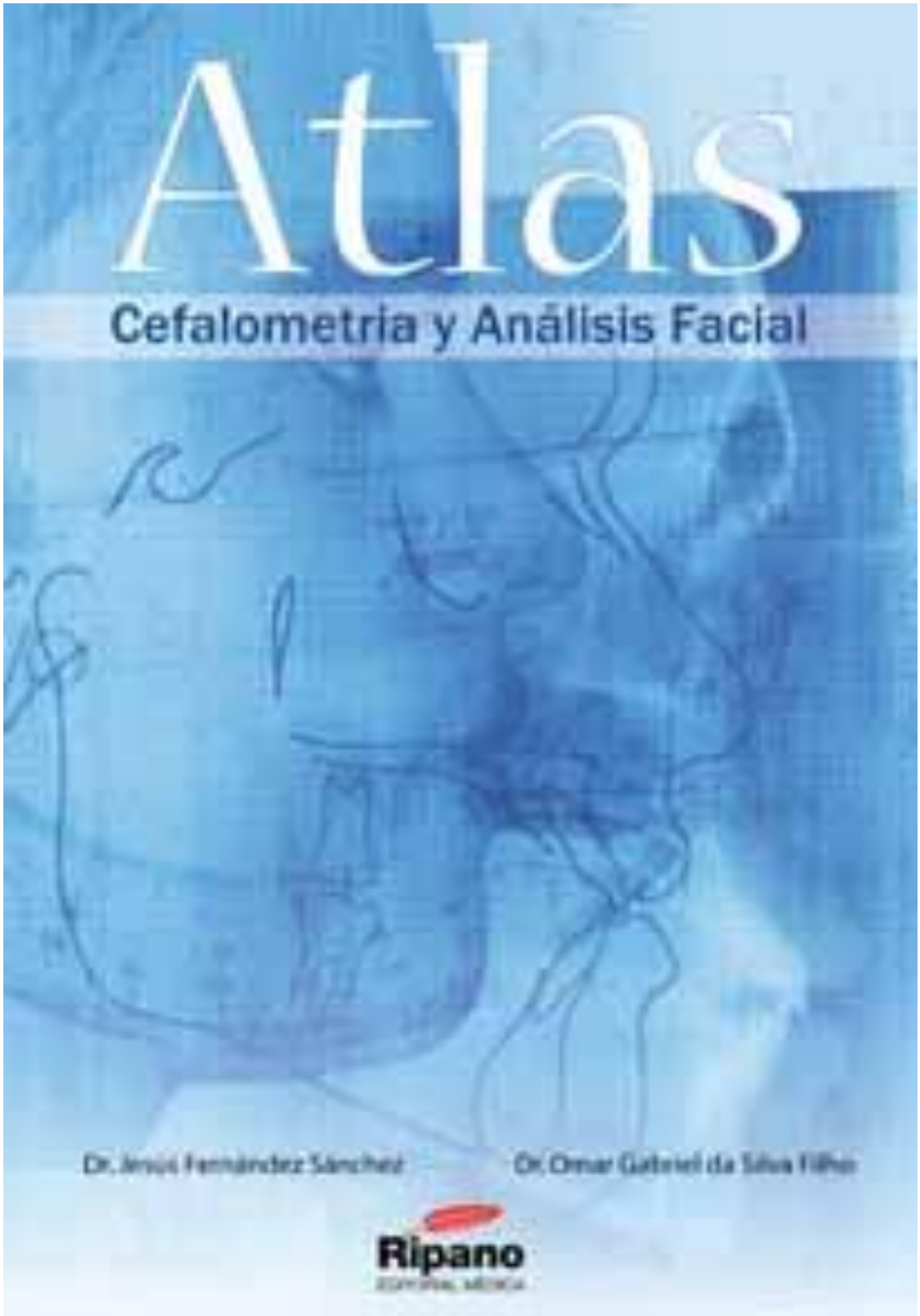
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Rapid maxillary expansion in growing patients. Hyrax versus transverse sagittal maxillary expander: a cephalometric investigation

Giampietro Farronato*, Cinzia Maspero*, Luca Esposito*, Enrico Briguglio*, Davide Farronato** and Lucia Giannini*

Departments of *Orthodontics and **Surgery, Fondazione IRCCS Cà Granda - Ospedale Maggiore Policlinico, University of Milan, Italy

Correspondence to: Professor Giampietro Farronato, Department of Orthodontics, University of Milan, Via Commenda 10, 20122 Milano, Italy. E-mail: giampietro.farronato@unimi.it

SUMMARY The aim of this retrospective study was to cephalometrically evaluate and compare the skeletal and dental effects of a transverse sagittal maxillary expander (TSME) and a Hyrax-type expander (RME) in children with maxillary hypoplasia.

Fifty subjects (26 males and 24 females), aged from 6 to 15 years, with a maxillary crossbite caused by basal apical narrowness, were divided into two equal groups. Twenty-five were treated with a TSME and the other 25 with a RME. For each patient, a lateral cephalogram was obtained before treatment (T0) and at the end of the retention period (T1). Changes in the two groups during the observation period were calculated, compared, and statistically analysed with a paired samples *t*-test.

In the TSME group, SNP–A, ISN, and IFH and in the RME group SN–SNP.SNA, N–Me, and U6.PP displayed a statistically significant increase ($P < 0.05$). The increase in SNP–A, ISN, and IFH in the TSME group was significantly greater following treatment than in the RME group.

The results support the use of the TSME to produce skeletal changes and dentoalveolar modification and to correct maxillary hypoplasia. It was also demonstrated that in patients with an anterior open bite, the use of the TSME is not contraindicated as the anterior vertical dimension did not increase significantly.

Introduction

Rapid maxillary expansion is widely used in the treatment of transverse maxillary deficiencies in order to re-direct growth of the basal bone into a normal pattern.

Aetiological causes of a posterior crossbite can be either genetic or environmental. Harvold *et al.* (1972) stated that a reduction of the transverse maxillary dimension is generally due to anomalous functions.

A constricted arch width should be treated as early as possible to promote normal function and correct tongue positioning (Clark, 2005).

A low tongue position is associated with a narrow palate that may predispose to mouth breathing and also cause upper anterior crowding. Maxillary hypoplasia may cause a Class II malocclusion and may restrict mandibular development in the sagittal or transverse dimensions (McNamara and Brudon, 1993; Farronato *et al.*, 2003) and may also predispose to a Class III occlusion (Farronato *et al.*, 2003).

Early treatment protocols have been proposed to correct maxillary hypoplasia, and dentoalveolar and muscular imbalance before skeletal maturation and eruption of the permanent dentition is complete (McNamara and Brudon, 1993).

A rapid maxillary expander (RME) can produce orthopaedic expansion affecting the skeletal structures rather than movement of teeth through alveolar bone (Wertz, 1970; Timms, 1976).

Cephalometrically, it has been observed that the maxilla is displaced downward and forward during maxillary expansion (Haas, 1961; Wertz, 1970; Wertz and Dreskin, 1977; Linder-Aronson and Lindgren, 1979; Da Silva *et al.*, 1991). Cleall (1974) found unfavourable effects in patients with a well-positioned maxilla and stated that in the retention period the maxilla generally returns to its original position. Furthermore, in a study of lateral cephalograms, Wertz (1970) found that the maxilla consistently dropped down but rarely moved significantly forward. Wertz and Dreskin (1977) noted no significant change in the angulation of the palate after RME therapy.

In the retrospective studies of Farronato *et al.* (1982, 1983) on 15 growing subjects with maxillary hypoplasia, the effects of RME in the three planes of space were investigated. The cephalometric tracings were analysed before and after treatment and at the end of the retention period. The results of their study confirmed widening of the maxilla in the transverse plane and an increase in the floor of the nose.

Components of Class III Malocclusion in Juveniles and Adolescents

Edmund C. Guyer
Edward E. Ellis, III
James A. McNamara, Jr.
Rolf G. Behrents

A statistical comparison of cross-sectional cephalometric records of Class III malocclusion subjects from ages 5–15 with serial Class I controls, finding strong tendencies for early appearance of distinctive characteristics.

KEY WORDS: • CEPHALOMETRICS • GROWTH AND DEVELOPMENT • • MALOCCLUSION, CLASS III • PROGNATHISM, MANDIBULAR •

Little definitive information is available on the dentofacial components of Class III malocclusion, and what has been reported remains controversial. The terms "mandibular prognathism" and "Angle Class III malocclusion" are generally regarded as similar if not synonymous in the dental literature, which has tended to overemphasize the importance of occlusal relationships by using occlusal terms in describing skeletal relationships.

Dr. Guyer is Senior Staff Orthodontist at Henry Ford Hospital, Detroit, Michigan and Clinical Assistant Professor of Orthodontics at the University of Detroit. He also holds an M.S. degree in orthodontics from the University of Detroit.

Dr. Ellis is Assistant Professor in Oral and Maxillofacial Surgery and co-director of the Dentofacial Program at the University of Michigan. He is also a Research Investigator in The Center for Human Growth and Development and in the Department of Anatomy and Cell Biology at the University of Michigan. He is a Dental Graduate of the University of Michigan, and holds an M.S. degree in Oral and Maxillofacial Surgery from the same institution.

Dr. McNamara is Professor of Dentistry (Orthodontics), Professor of Anatomy and Cell Biology, and Research Scientist at the Center for Human Growth and Development at the the University of Michigan. He is also in the private practice of orthodontics in Ann Arbor, Michigan. He is a Dental and Orthodontic graduate of the University of California, San Francisco, and holds a Ph.D. degree in Anatomy from The University of Michigan.

Dr. Behrents is Chairman of the Department of Orthodontics at the University of Tennessee in Memphis. He is a Dental graduate of Meharry College, an Orthodontic graduate of Case Western Reserve University, and holds a Ph.D. degree in Human Growth and Development from the University of Michigan.

Author Address:
Dr. E. E. Ellis
Department of Oral
and Maxillofacial Surgery
The University of Michigan
School of Dentistry
Ann Arbor, MI 48109

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ELSEVIER

Long-term evaluation of the efficacy on the podalic support and postural control of a new elastic functional orthopaedic device for the correction of Class III malocclusion

E. Bardellini, M. G. Gulino, S. Fontana, J. Merlo, M. Febbrari, A. Majorana

University of Brescia, Italy

e-mail: elena.bardellini@unibs.it

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Abstract

Aim Correlations between occlusion and posture are open to new perspectives, which include treatment of functional alterations traditionally approached separately. The aim of this study is to evaluate whether the treatment of Class III malocclusion, through an innovative elastic functional orthopaedic device, allows an overall improvement of the podalic support.

Methods A 5½-year-old patient with Angle Class III malocclusion and c anterior ross bite in deciduous dentition has been treated for 7 years with a functional orthopaedic device (MSB Class III). Assessment of frontal and lateral postural plumb line was performed with stabilo-baro-podometric platform analysis, in order to record the podalic support discrepancy between feet, both in static phase and in dynamic phase. The patient has been posturally re-evaluated at nine and twelve years old.

Results The functional device allowed the restoration of the correct intermaxillary relationship, favourably conditioning also the posture. In particular, the correction of the valgus flat foot and a significative reduction of the podalic support discrepancy between feet has been obtained.

Conclusions A global approach to the patient can successfully address both malocclusion and postural alterations.

KEYWORD Malocclusion, Posture, Functional orthopaedics, Stabilometric-baropodometric platform.

Introduction

The hypothesis of correlations between occlusion and posture has recently been officially recognised by the scientific community, and a global approach to such disorders is considered an effective treatment [National Posturology Guidelines, Italy, 2017]. Functional alterations (i.e. lingual interposition, finger or tongue sucking, postural alterations, oral breathing, etc.) are recognized as the environmental factors mostly implicated in the diagnosis of malocclusion, due to their effect on the intraoral and extraoral muscles, with consequent morpho-functional changes at the dental-alveolar and/or skeletal level [Ackerman et al., 2009; Agenter et al., 2009; Ciavarella et al., 2010].

Class III malocclusions are often correlated to a low and anterior posture of the tongue, with consequent risk of mandibular protrusion [Iwasaki et al., 2017].

Since the jaw, through the hyoid bone, is functionally connected to the cranial structures and to those of the cervical district (through fascial and muscle-ligaments components), its malposition could induce an unbalancing effect on the whole postural order [Rocabado, 1983].

The repositioning of the tongue through a functional appliance could help a correct growth and development of the patient, and the restoration of functional swallowing and breathing [Tollaro et al., 1996; Suárez et al., 2014].

The aim of this study is to present a long term-evaluation, for a total of 7 years, of the posture of a child treated with an elastic functional orthopaedic device.

Materials and methods

A 5½-year-old girl in deciduous dentition presented Angle Class III bilateral malocclusion, with anterior cross bite. Treatment started with a functional orthopaedic device (Mouth Slow Balance, MSB, Class III).

Postural examination with plumb line and stabilo-baropodometric platform analysis in static and dinamic posture were performed.

Review Article

Orthopedic Treatment Outcomes in Class III Malocclusion

A Systematic Review

Laura De Toffol[a]; Chiara Pavoni[a]; Tiziano Baccetti[b]; Lorenzo Franchi[b]; Paola Cozza[c]

ABSTRACT

Objective: To assess the scientific evidence on the effectiveness of early orthopedic treatment in Class III subjects.

Materials and Methods: A literature survey was performed by applying the Medline database (Entrez PubMed). The survey covered the period from January 1966 to December 2005 and used the Medical Subject Headings (MeSH). The following study types that reported data on the effects of Class III treatment with orthopedic appliances (facial mask, chincup, FR-3) on intermaxillary sagittal and vertical relationships were included: randomized clinical trials (RCTs), and prospective and retrospective longitudinal controlled clinical trials (CCTs) with untreated Class III controls.

Results: The search strategy resulted in 536 articles. After selection according to criteria for inclusion and exclusion, 19 articles qualified for the final review analysis. One RCT and 18 CCTs were retrieved.

Conclusion: The quality standard of the retrieved investigations ranged from low (four studies) to medium/high (five studies). Data derived from medium/high quality research described over 75% of success of orthopedic treatment of Class III malocclusion (RME and facial mask therapy) at a follow-up observation 5 years after the end of orthopedic treatment.

KEY WORDS: Systematic review; Class III malocclusion; Orthopedic treatment; Early treatment

INTRODUCTION

Class III malocclusion is associated with a deviation in the sagittal relationship of the maxilla and the mandible, characterized by a deficiency and/or a backward position of the maxilla, or by prognathism and/or forward position of the mandible.[1] The incidence of this malocclusion in the white population has been reported to be 1% to 5%.[2–4] In the Asian populations, however, the incidence ranges from 9% to 19%,[5–7] and in Latin populations the incidence is approximately 5%.[8,9]

The etiology of Class III malocclusion is multifactoral because of an interaction of both hereditary and environmental factors. The contributions of the cranial base, maxilla, mandible, and temporomandibular articulation have been described in detail in the literature.[10–13] Class III malocclusions associated with craniofacial disharmonies are much more difficult to treat and tend to relapse.[14–16]

Early treatment of Class III malocclusion has been advocated to reduce the need of treatment in the permanent dentition, when camouflage orthodontic treatment or surgery become the only options.[1] A series of treatment approaches can be found in the literature regarding orthopedic treatment in Class III malocclusion.

The aim of the present study is to analyze the scientific evidence on the actual outcomes of orthopedic treatment in Class III malocclusion as derived from the existing literature on peer-reviewed orthodontic journals according to the Cochrane collaboration principles. This systematic review was undertaken to answer the following relevant questions:

- Is early orthopedic treatment of Class III malocclusion effective?
- Which treatment modality is the most effective?

[a] Research Fellow, Department of Orthodontics, University of Rome 'Tor Vergata', Italy.

[b] Assistant Professor, Department of Orthodontics, University of Florence; Thomas M. Graber Visiting Scholar, Department of Orthodontics and Pediatric Dentistry, School of Dentistry, The University of Michigan, Ann Arbor, Mich.

[c] Professor and Head, Department of Orthodontics, University of Rome 'Tor Vergata', Italy.

Corresponding author: Tiziano Baccetti, DDS, PhD, Università degli Studi di Firenze, Via del Ponte di Mezzo, 46-48, 50127, Firenze, Italy
(e-mail: t.baccetti@odonto.unifi.it)

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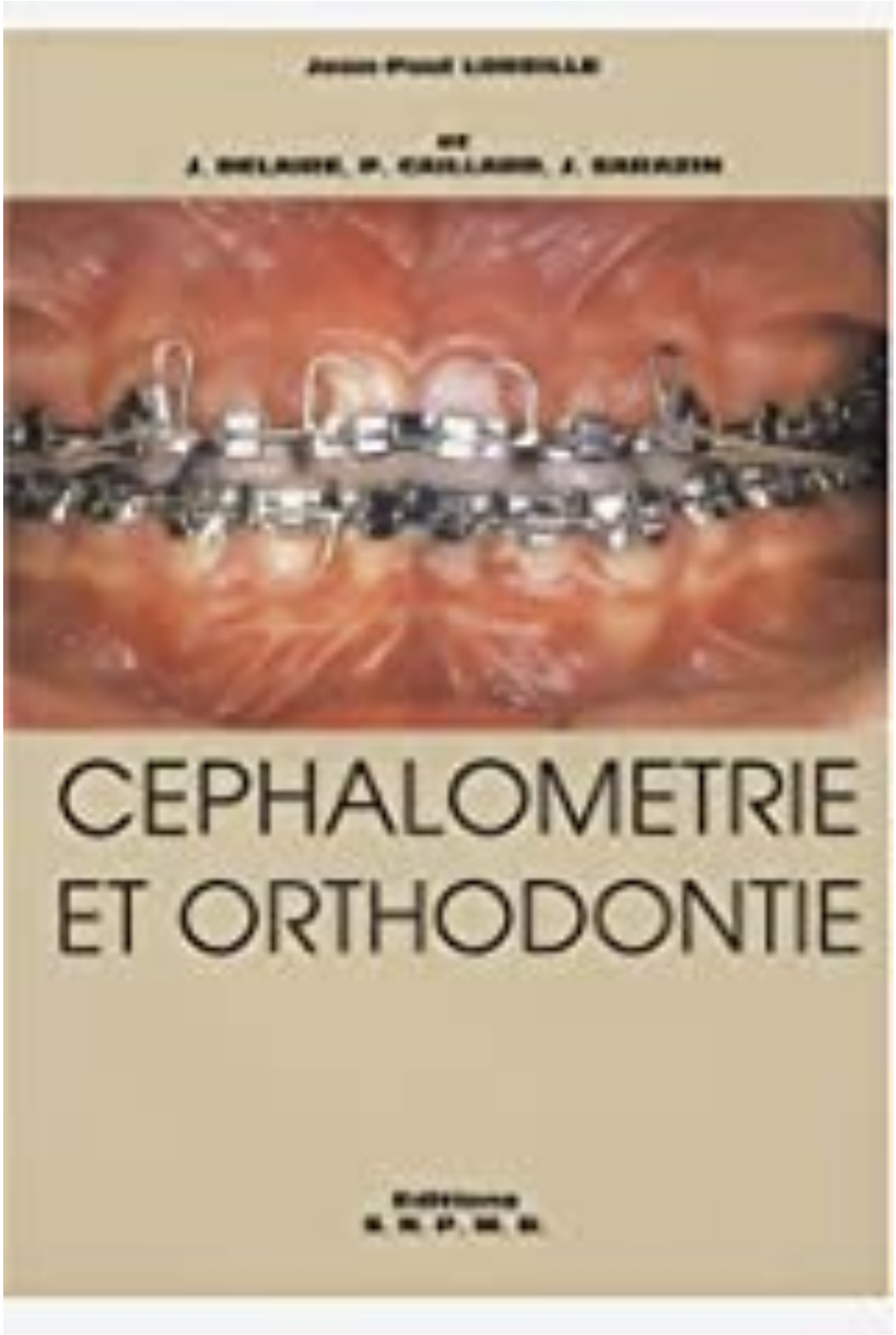
CEPHALOMETRIE
ET ORTHODONTIE

Skeletal effects of early treatment of Class III malocclusion with maxillary expansion and face-mask therapy

Tiziano Baccetti, DDS, PhD,[a] Jean S. McGill, DDS, MS,[b] Lorenzo Franchi, DDS, PhD,[c] James A. McNamara Jr., DDS, PhD,[d] and Isabella Tollaro, MD, DDS[e]
Florence, Italy, Eaton, Pa., and Ann Arbor, Mich.

The effectiveness of maxillary expansion and face-mask therapy in children with Class III malocclusion was studied in a sample of 46 subjects in mixed dentition and compared with a control sample of 32 subjects with untreated Class III malocclusion. Treated and untreated samples were divided into early and late mixed-dentition groups to aid identification of the optimum timing of the orthopedic treatment of the underlying skeletal disharmony. Cephalometric analysis was based on a stable basicranial reference system, appropriate for longitudinal studies started in the early developmental ages. The level of significance for intergroup comparisons was set at a p value of 0.01. Significant forward displacement of the maxillary complex was found in the early-treatment group. The region of the pterygomaxillary suture, in particular, showed significant changes in the subjects treated during early mixed dentition. No significant maxillary modifications were recorded in the late-treatment group. Both early and late groups exhibited smaller increments in mandibular protrusion and larger increments in the intermaxillary vertical relationship compared with their respective Class III control groups. Only children treated at an early age, however, showed a significant upward and forward direction of condylar growth, leading to smaller increments in total mandibular length. These results indicate that the combination of a bonded maxillary expander and face-mask therapy is more effective in early mixed dentition than in late mixed dentition, especially with regard to the magnitude of the protraction effects on maxillary structures. (Am J Orthod Dentofacial Orthop 1998;113:333-43.)

Face-mask therapy was first described more than a century ago,[1] and since the late 1960s it has been used with increasing frequency for the correction of Class III malocclusion.[2-9] Despite this popularity, most of the literature concerning the skeletal and dental changes induced with the face mask are in the form of case reports,[5-7,10-14] with few methodologically sound clinical studies. Longitudinal cephalometric data on untreated Class III subjects to which the treatment effects produced by the facial mask can be contrasted are also scarce.

Much of the information about the skeletal effects of protraction forces still derives from animal studies. Maxillary forward movement and sutural remodeling have been the main treatment effects noted by several investigators in nonhuman primates.[15-18] Kambara[16] found changes at the circummaxillary sutures and at the maxillary tuberosity attributable to posteroanterior traction, including the opening of sutures, stretching of sutural connective-tissue fibers, new bone deposition along the stretched fibers, and apparent tissue homeostasis that maintained the sutural width. Nanda and Hickory[18] showed how the histologic modifications in the zygomaticomaxillary suture after maxillary protraction varied according to the orientation of the force system applied. Biomechanical studies on dry human skulls have demonstrated further that the application of an anteriorly directed force results in forward movement of the maxilla.[14,19,20] These investigations also showed that the direction of the force is critical in controlling rotation of the upper jaw. A force generated parallel to the maxilla or above the palatal plane produces counterclockwise rotation of the palatal plane.

[a]Postdoctoral Resident, Department of Orthodontics, University of Florence, Florence, Italy.
[b]Graduate Orthodontic Program, University of Michigan, and private practice, Eaton, Penn.
[c]Doctoral Program in Preventive Orthodontics, Department of Orthodontics, University of Florence.
[d]Professor of Dentistry, Department of Orthodontics and Pediatric Dentistry, School of Dentistry; Professor of Anatomy and Cell Biology, School of Medicine; and Research Scientist, Center for Human Growth and Development, University of Michigan.
[e]Professor, Head, and Chairman, Department of Orthodontics, University of Florence.
Reprint requests to: Tiziano Baccetti, DDS, Università degli Studi di Firenze, Via del Ponte di Mezzo, 46-48, 50127, Firenze, Italy.
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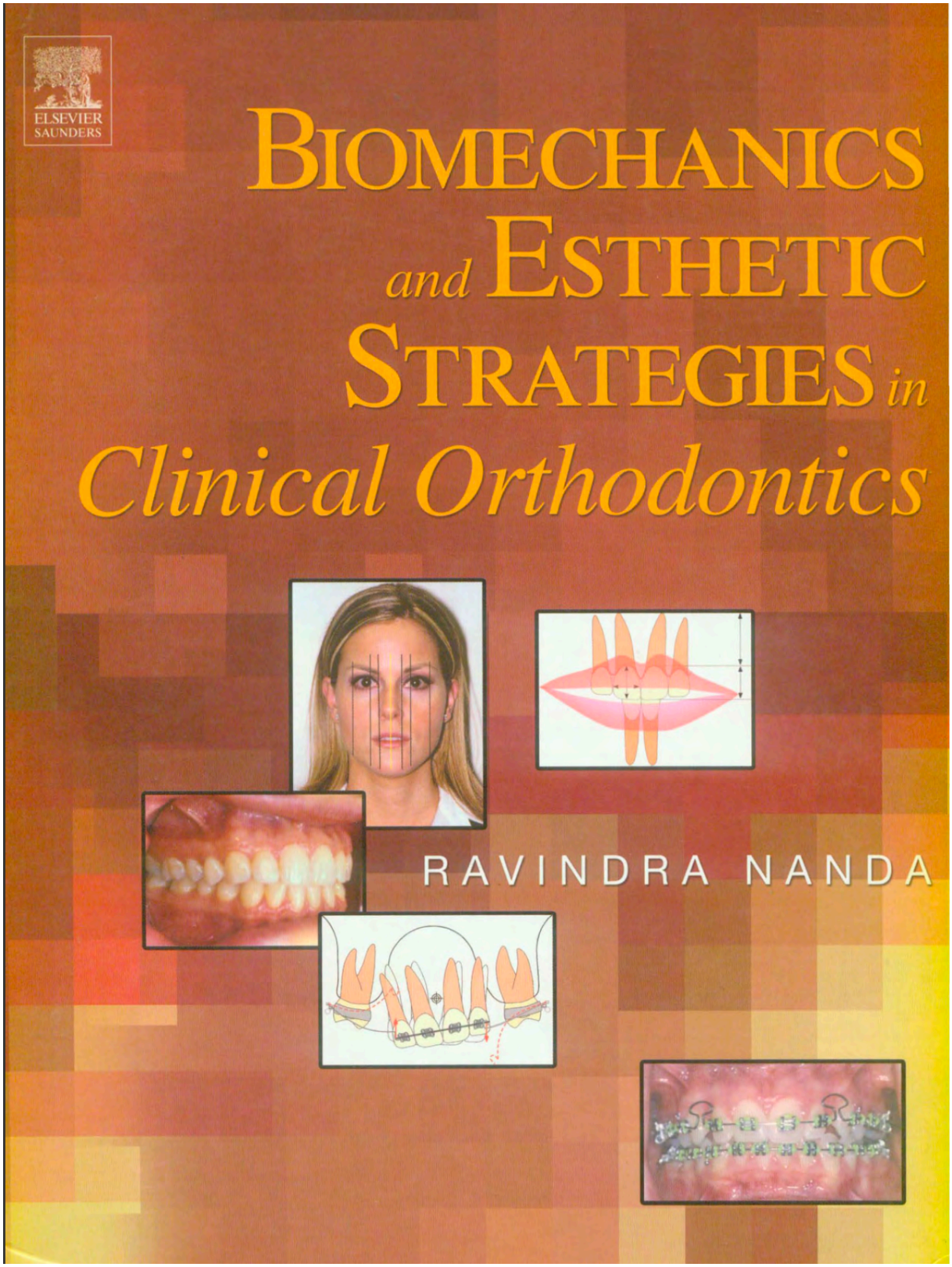
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Palatal growth studied on human autopsy material

A histologic microradiographic study

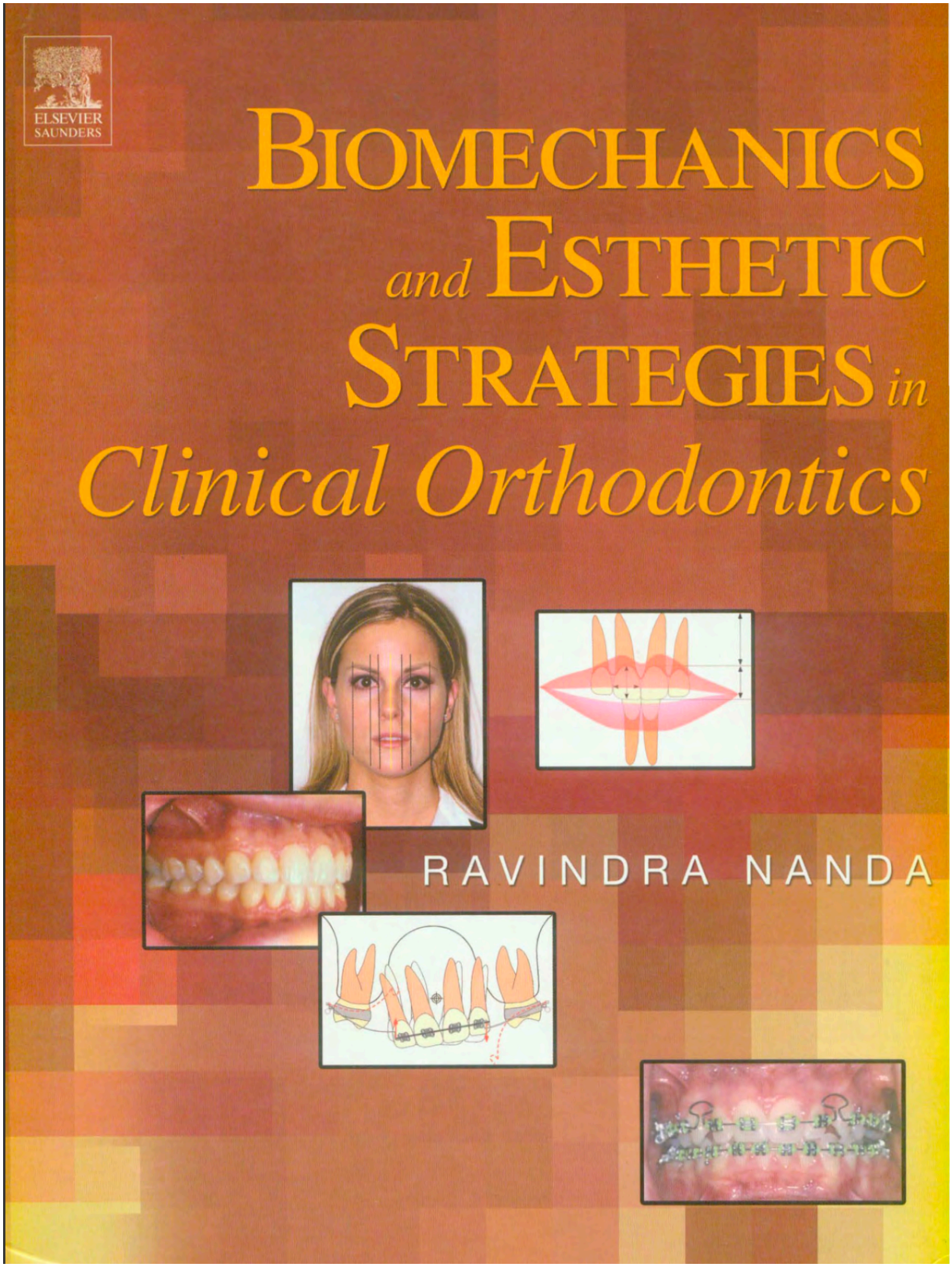
B. Melsen, D.D.S., Dr.odont.
Aarhus, Denmark

The most important information on the vertical growth of the hard palate has been obtained in longitudinal roentgen-cephalometric studies by Björk[3, 5, 7] by means of the implant method. These studies have shown that lowering of the maxillary area of the hard palate is due to bone resorption on the nasal side of the hard palate and to apposition on the oral side. It was further shown by Björk and Skieller[8] that remodeling of the nasal side of the hard palate is differentiated, as the resorption is usually greater on the anterior part of the nasal surface. The information obtained in these studies applies only to the growth of the maxillary part of the hard palate, as the implants were always placed in the maxilla. The vertical growth pattern of the horizontal plate of the palatine bone has not previously been studied.

The growth in length of the hard palate has been described by, among others, Koski,[15] Bambha,[1] Taylor,[31] Björk,[4] Melsen,[18] and Fishman,[14] and in all of these studies the growth was found to continue until adulthood. However, there has not been any investigation of the extent to which the increase in palatal length is due to growth in the transverse palatal suture and the extent to which it is due to apposition on the posterior margin.

Regarding the growth activity of the midpalatal suture, various opinions have been expressed. Scott[26] considered that growth in the suture ceased at the age of 1 year. On the other hand, Latham and Burston[16] and Latham,[17] who studied the suture histologically, observed growth at the age of 3 years, and Persson[23] observed signs of growth in the suture at the age of 13. Björk[5] had previously pointed out that growth activity in the midpalatal suture continues for a considerably longer period than formerly believed. This has recently been confirmed in implant studies reported by Björk and Skieller.[9]

From the Department of Orthodontics, The Royal Dental College, Vennelyst Boulevard, DK-8000 Aarhus C, Denmark.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STRATEGIES in
Clinical Orthodontics
RAVINDRA NANDA

The Dilemma of Class III Treatment

Early or Late?

PHILLIP M. CAMPBELL

Dr. Campbell is in the private practice of orthodontics in Huntsville, Texas. He is on the teaching staffs of the Department of Orthodontics at Baylor University in Dallas, and the Charles H. Tweed Foundation for Orthodontic Research in Tucson. He holds an M.A. degree in Biology-Biochemistry from Southwest Texas State University in San Marcos, and D.D.S. and M.S.D. in Orthodontics from Baylor University. He is a Diplomate of the American Board of Orthodontics.

Address:
Dr. Phillip M. Campbell
2700 Lake Road at Windsor
Huntsville, TX 77340

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A clinical study of the results of various types of early Class III treatment in 14 patients, with emphasis on the reverse-pull face crib. The conclusion is that the important benefits of early treatment should not be denied because of concerns that a few may still require further treatment later.

Timing of orthodontic treatment has always been somewhat controversial. Many practitioners, after some frustrating experiences with the complexities of treatment in the mixed dentition, have chosen to postpone most orthodontic treatment until all permanent teeth are present.

Extraoral anchorage and functional appliances have proven very useful in correcting Class II conditions in the growing patient, and there has been great interest in the details of their application. Unfortunately, the same enthusiasm for interceptive treatment in the developing Class III patient has not gained such popularity.

Although the treatment of Class III malocclusion has received a considerable amount of attention during this century, most of this treatment has been focused on a combined orthodontic/surgical correction. Even today, many Class III patients are not treated until the orthodontist feels that active growth is complete.

SYSTEMATIC REVIEW CE AJO-DO

Early orthodontic treatment for Class III malocclusion: A systematic review and meta-analysis

See Choong Woon and Badri Thiruvenkatachari
Manchester, United Kingdom

Introduction: Class III malocclusion affects between 5% and 15% of our population. The 2 most common dilemmas surrounding Class III treatment are the timing of treatment and the type of appliance. A number of appliances have been used to correct a Class III skeletal discrepancy, but there is little evidence available on their effectiveness in the long term. Similarly, early treatment of Class III malocclusion has been practiced with increasing interest. However, there has been no solid evidence on the benefits in the long term. The aim of this systematic review was to evaluate the effectiveness of orthodontic/orthopedic methods used in the early treatment of Class III malocclusion in the short and long terms. **Methods:** Several sources were used to identify all relevant studies independently of language. The Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Embase (Ovid), and MEDLINE (Ovid) were searched to June 2016. The selection criteria included randomized controlled trials (RCTs) and prospective controlled clinical trials (CCTs) of children between the ages of 7 and 12 years on early treatment with any type of orthodontic/orthopedic appliance compared with another appliance to correct Class III malocclusion or with an untreated control group. The primary outcome measure was correction of reverse overjet, and the secondary outcomes included skeletal changes, soft tissue changes, quality of life, patient compliance, adverse effect, Peer Assessment Rating score, and treatment time. The search results were screened for inclusion, and the data extracted by 2 independent authors. The data were analyzed using software (version 5.1, Review Manager; The Nordic Cochrane Centre, The Cochrane Collaboration; Copenhagen, Denmark). The mean differences with 95% confidence intervals were expressed for the continuous data. Random effects were carried out with high levels of clinical or statistical heterogeneity and fixed affects when the heterogeneity was low. **Results:** Fifteen studies, 9 RCTs and 6 CCTs, were included in this review. In the RCT group, only 3 of 9 studies were assessed at low risk of bias, and the others were at high or unclear risk of bias. All 6 CCT studies were classified as high risk of bias. Three RCTs involving 141 participants looked at the comparison between protraction facemask and untreated control. The results for reverse overjet (mean difference, 2.5 mm; 95% CI, 1.21-3.79; $P = 0.0001$) and ANB angle (mean difference, 3.90°; 95% CI, 3.54-4.25; $P < 0.0001$) were statistically significant favoring the facemask group. All CCTs demonstrated a statistically significant benefit in favor of the use of each appliance. However, the studies had high risk of bias. **Conclusions:** There is a moderate amount of evidence to show that early treatment with a facemask results in positive improvement for both skeletal and dental effects in the short term. However, there was lack of evidence on long-term benefits. There is some evidence with regard to the chincup, tandem traction bow appliance, and removable mandibular retractor, but the studies had a high risk of bias. Further high-quality, long-term studies are required to evaluate the early treatment effects for Class III malocclusion patients.
Trial registration number: PROSPERO CRD42015024252. (Am J Orthod Dentofacial Orthop 2017;151:28-52)

School of Dentistry, University of Manchester, Manchester, United Kingdom.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
Address correspondence to: Badri Thiruvenkatachari, School of Dentistry, JR Moore Building, University of Manchester, Manchester, United Kingdom M13 9PL; e-mail, Badri.T@manchester.ac.uk.
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Early treatment of Class III malocclusion has been attempted with varying success. The main advantage of early Class III malocclusion treatment is to avoid surgical intervention and thus reduce the morbidity of the surgery. The timing of early treatment is crucial for a successful outcome. Some studies have reported that treatment should be carried out in patients less than 10 years of age to enhance the orthopedic effect.[1-4] In contrast, other studies have

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Progress in Orthodontics

RESEARCH Open Access

A novel method for treatment of Class III malocclusion in growing patients

Saad A. Al-Mozany[1], Oyku Dalci[1], Mohammed Almuzian[1,2,3*], Carmen Gonzalez[1], Nour E. Tarraf[1] and M. Ali Darendeliler[1]

Abstract

Background: Management of Class III malocclusion is one of the most challenging treatments in orthodontics, and several methods have been advocated for treatment of this condition. A new treatment protocol involves the use of an alternating rapid maxillary expansion and constriction (Alt-RAMEC) protocol, in conjunction with full-time Class III elastic wear and coupled with the use of temporary anchorage devices (TADs). The aim of this study was to evaluate the dento-skeletal and profile soft tissue effects of this novel protocol in growing participants with retrognathic maxilla.

Methods: Fourteen growing participants (7 males and 7 females; 12.05 ± 1.09 years), who displayed Class III malocclusions with retrognathic maxilla, were recruited. Pre-treatment records were taken before commencing treatment (T1). All participants had a hybrid mini-implant-supported rapid maxillary expansion (MARME) appliance that was activated by the Alt-RAMEC protocol for 9 weeks. Full-time bone-anchored Class III elastics, delivering 400 g/side, were then used for maxillary protraction. When positive overjet was achieved, protraction was ceased and post-treatment records were taken (T2). Linear and angular cephalometric variables were blindly measured by one investigator and repeated after 1 month. An error measurement (Dahlberg's formula) study was performed to evaluate the intra-examiner reliability. A paired-sample *t* test ($p < 0.05$) was used to compare each variable from T1 to T2.

Results: Treatment objectives were achieved in all participants within 8.5 weeks of protraction. The maxilla significantly protracted (SNA 1.87°± 1.06°; Vert.T-A 3.29± 1.54 mm $p < 0.001$), while the mandibular base significantly redirected posteriorly (SNB −2.03° ± 0.85°, Vert.T-B − 3.43± 4.47 mm, $p < 0.001$ and $p < 0.05$ respectively), resulting in a significant improvement in the jaw relationship (ANB 3.95°± 0.57°, $p < 0.001$; Wits 5.15± 1.51 mm, $p < 0.001$). The Y-axis angle increased significantly
(1.95° ± 1.11°, $p < 0.001$). The upper incisors were significantly proclined (+ 2.98°± 2.71°, $p < 0.01$), coupled with a significant retroclination of the lower incisors (− 3.2°± 3.4°, $p < 0.05$). The combined skeletal and dental effects significantly improved the overjet (5.62± 1.36 mm, $p < 0.001$) and the soft tissue Harmony angle (2.75° ± 1.8°, $p < 0.001$).

Conclusions: Class III elastics, combined with the Alt-RAMEC activation protocol of the MARPE appliance, is an efficient treatment method for mild/moderate Class III malocclusions. The long-term stability of these changes needs further evaluation.

* Correspondence: dr_muzian@hotmail.com
[1]Discipline of Orthodontics, Faculty of Dentistry, University of Sydney, Sydney, Australia
[2]Oxford University Hospitals, NHS Foundation Trust, Oxford 0X3 9DU, UK
Full list of author information is available at the end of the article

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RESEARCH Open Access

Facemask performance during maxillary protraction: a finite element analysis (FEA) evaluation of load and stress distribution on Delaire facemask

Francesca Gazzani[1*], Chiara Pavoni[1,2], Aldo Giancotti[1], Paola Cozza[1,2] and Roberta Lione[1,2]

Abstract

Background: To evaluate load and stress distribution on Delaire facemask (FM) during maxillary protraction in class III growing patients by means of finite element analysis (FEA). A three-dimensional geometry of a Delaire FM was reconstructed from the original CAD 3D prototype, using software package (ANSYS 5.7). FM presented forehead and chin supports and stainless steel framework characterized by two lateral vertical bars connected to a crossbar with two pawls for elastic attachment. Two traction intensities (7.8 and 9.8 N) were applied on the FM pawls along three different downward inclined directions with respect to the occlusal plane (0°, 30°, or 50°, respectively). Resulting stresses and deformations were then tested through the von Mises yield criterion in order to underline the FM wear performance.

Results: The analysis showed that higher stresses and deformations are mostly related to axial forces of 9.8 N rather than 7.8 N. Stresses also progressively increased with increasing downward force inclinations (0°, 30°, and 50° with respect to the occlusal plane). The overall tensions were inferior to the limit of the elastic behavior (yield point) characterizing the material they are applied on. Thus, the FM structure absorbed the load applied with an elastic deformation of the lateral and horizontal bars.

Conclusions: Resulting stresses and deformations were directly proportional to protraction load amounts and to increasing downward inclination of forces. In all tested conditions, protraction forces were not able to determine plastic deformation on FM structure compromising its performance and efficiency.

Keywords: Delaire face mask, Maxillary protraction, Class III malocclusion, FEM analysis

Background

Maxillary protraction with facemask (FM) is an orthopedic approach widely used in the treatment of class III growing patients [1–8]. The FM was firstly described more than 100 years ago, but its use was lately diffused by Jean Delaire [9, 10]. Maxillary protraction therapy aims to transmit extra-oral tension forces on the circum-maxillary sutures in order to obtain a forward displacement of the maxilla stimulating bone apposition in the suture areas and resulting in an improvement of skeletal sagittal relationship [11, 12]. Although several anchorage devices have been developed [13, 14] to maximize the efficiency of the anchorage system, the Delaire FM design has never been changed over the years. Delaire FM consists of two extraoral anchorage regions, forehead and chin cups, connected to rigid and square-shaped metal framework [9, 10]. Metal component is composed of two lateral vertical bars and a crossbar with two pawls for elastic attachment [4, 9, 10]. The horizontal bar is connected to lateral vertical bars by means of two cylindrical stainless steel latches. Both the FM plastic and metallic components can be adjusted individually to adapt the FM to the size of patient's

* Correspondence: francescagazzani@hotmail.it
[1]Department of Clinical Sciences and Translational Medicine, University of Rome 'Tor Vergata', Via Collazia 29, 00183 Rome, Italy
Full list of author information is available at the end of the article

Growth modification of the face: A current perspective with emphasis on Class III treatment


Hugo J. De Clerck[a] and William R. Proffit[b]
Chapel Hill, NC, and Brussels, Belgium

A summary of the current status of modification of jaw growth indicates the following. 1. Transverse expansion of the maxilla is easy before adolescence, requires heavy forces to create microfractures during adolescence, and can be accomplished only with partial or complete surgical osteotomy after adolescence. Transverse expansion of the mandible or constriction of either jaw requires surgery. 2. Acceleration of mandibular growth in preadolescent or adolescent patients can be achieved, but slower than normal growth afterward reduces or eliminates a long-term increase in size of the mandible. Restraint of maxillary growth occurs with all types of appliances to correct skeletal Class II problems. For short-face Class II patients, increasing the face height during preadolescent or adolescent orthodontic treatment is possible, but it may make the Class II problem worse unless favorable anteroposterior growth occurs. For those with a long face, controlling excessive vertical growth during adolescence is rarely successful. 3. Attempts to restrain mandibular growth in Class III patients with external forces largely result in downward and backward rotation of the mandible. Moving the maxilla forward with external force is possible before adolescence; moving it forward and simultaneously restricting forward mandibular growth without rotating the jaw is possible during adolescence with intermaxillary traction to bone anchors. The amount of skeletal change with this therapy often extends to the midface, and the short-term effects on both jaws are greater than with previous approaches, but individual variations in the amount of maxillary vs mandibular response occur, and it still is not possible to accurately predict the outcome for a patient. For all types of growth modification, 3-dimensional imaging to distinguish skeletal changes and better biomarkers or genetic identification of patient types to indicate likely treatment responses are needed. (Am J Orthod Dentofacial Orthop 2015;148:37-46)

Although growth modification has been considered important from the beginning of orthodontics, the concepts underlying its use and the views of its clinical usefulness have varied greatly over time. To orthodontists in the late 19th and early 20th centuries, growth modification was easy because it was assumed that growth was largely controlled by environmental factors and was judged as successful because the dental occlusion improved. By midcentury, cephalometrics had shown that most of the changes produced by the treatment methods of that time were tooth movement, not modified growth. At that point, the American view was that it was almost impossible to modify growth because of tight genetic control, and that attempts to do so were rarely indicated. Europeans remained more positive; in the United States, there was increasing acceptance of European functional appliances and enthusiasm for growth modification in the last quarter of the century. There is a somewhat less enthusiastic view of it now, as better data for long-term outcomes have become available, and genetic influences once again are being emphasized.

In this article, we had 2 goals: (1) to provide an overview of growth modification possibilities and limitations based on the best current data for the various types of malocclusions, and (2) to discuss in more detail Class III growth modification with elastics to bone anchors, the most recent form of growth modification and, in terms of short-term changes, perhaps the most successful.

[a]Adjunct professor, Department of Orthodontics, School of Dentistry, University of North Carolina, Chapel Hill, NC; private practice, Brussels, Belgium.
[b]Kenan distinguished professor, Department of Orthodontics, School of Dentistry, University of North Carolina, Chapel Hill, NC.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
Address correspondence to: Hugo J. De Clerck, Kerkstraat 120, 1150 Brussels, Belgium; e-mail, hugo.declerck@skynet.be.
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Progress in Orthodontics

RESEARCH Open Access

Facemask performance during maxillary protraction: a finite element analysis (FEA) evaluation of load and stress distribution on Delaire facemask

Francesca Gazzani[1*], Chiara Pavoni[1,2], Aldo Giancotti[1], Paola Cozza[1,2] and Roberta Lione[1,2]

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Background: To evaluate load and stress distribution on Delaire facemask (FM) during maxillary protraction in class III growing patients by means of finite element analysis (FEA). A three-dimensional geometry of a Delaire FM was reconstructed from the original CAD 3D prototype, using software package (ANSYS 5.7). FM presented forehead and chin supports and stainless steel framework characterized by two lateral vertical bars connected to a crossbar with two pawls for elastic attachment. Two traction intensities (7.8 and 9.8 N) were applied on the FM pawls along three different downward inclined directions with respect to the occlusal plane (0°, 30°, or 50°, respectively). Resulting stresses and deformations were then tested through the von Mises yield criterion in order to underline the FM wear performance.

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* Correspondence: francescagazzani@hotmail.it
[1]Department of Clinical Sciences and Translational Medicine, University of Rome 'Tor Vergata', Via Collazia 29, 00183 Rome, Italy
Full list of author information is available at the end of the article

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Maxillary protraction using a hybrid hyrax-facemask combination

Manuel Nienkemper*, Benedict Wilmes, Alexander Pauls and Dieter Drescher

Abstract

Background: The aim of this in study was the evaluation of treatment outcomes after using a hybrid hyrax-facemask combination in growing class III patients.

Methods: Treatment of 16 children (mean age 9.5 ± 1.3 years) was investigated clinically and by means of pre- and post-treatment cephalograms. Changes in sagittal and vertical, and dental and skeletal values were evaluated and tested for statistically significant differences.

Results: All mini-implants remained stable during treatment. Mean treatment duration was 5.8 ± 1.7 months. There was a significant improvement in skeletal sagittal values: SNA, +2.0°; SNB, −1.2°; ANB, +3.2°; WITS appraisal, +4.1 mm and overjet, +2.7 mm. No significant changes were found concerning vertical skeletal relationships and upper incisor inclination. In relation to A point, the upper first molars moved mesially about 0.4 mm ($P = 0.134$).

Conclusions: The hybrid hyrax-facemask combination seems to be effective for orthopaedic treatment in growing class III patients. Unwanted maxillary dental movements can be avoided due to stable skeletal anchorage.

Background

Treatment of skeletal class III malocclusion still seems to be one of the most ambitious challenges in orthodontics. This kind of malocclusion can be caused by a retrognathic maxilla, a prognathic mandible or a combination of both [1]. A surgical correction after the completion of growth is unavoidable in many cases, especially in cases with a prognathic mandible.

For patients with maxillary deficiency, the use of a facemask for protraction of the maxilla is one of the most common therapies. It was introduced by Delaire in 1971 [2]. The orthopaedic treatment of class III malocclusion is particularly efficient in patients during the early developmental phases [3-7]. For this reason, treatment should start in the early mixed dentition. The literature provides evidence that this is an effective method to treat a maxillary deficiency [4].

The use of a facemask for class III correction may also cause problems. The forces for maxillary protraction are normally applied to the upper teeth. As a result, a significant mesial migration of the upper teeth can be observed [8]. This may cause severe anterior crowding and reduce the orthopaedic treatment effects [9].

To avoid this side effect, different kinds of anchorage protocols were described in the literature. First, artificially ankylosed teeth were used to reduce dental effects [10]. Later, dental implants and surgical plates transferred the forces directly to the upper jaw [11,12].

To increase the skeletal effect on the maxilla, facemask therapy is often combined with rapid maxillary expansion (RME). A stimulating effect on the midfacial sutures caused by distraction with an improved response on protraction is expected. Even though it was discussed controversially [13], the analysis of the literature data affirms the benefit of the treatment combination [4]. Because of the well-known problems caused by tooth-borne expansion devices such as buccal tipping, gingival recessions or root damage, techniques based on bone-borne devices are described. Pure bone-borne Rapid Palatal Expansion (RPE) device can be used [14,15]. Besides the high invasiveness for insertion, they may also cause root lesions and infections [14]. To minimize the

* Correspondence: Manuel.Nienkemper@uni-duesseldorf.de
University of Düsseldorf, Department of orthodontics, Moorenstr. 5, 40225 Düsseldorf, Germany

Original Article

Effect of Varying the Force Direction on Maxillary Orthopedic Protraction

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

Abstract: The aim of this study was to examine the effect of varying the force direction on maxillary protraction. A total of 20 patients with class III maxillary retrognathism were randomly divided into two groups. Group 1 was comprised of nine patients with a mean age of 8.58 years, and group 2 was composed of 11 patients with a mean age of 8.51 years. Both groups received a cap splint–type rapid palatal expander and the screw was activated twice a day for 10 days. After the expansion procedure the face mask protraction procedure was initiated. In group 1, we applied the force intraorally from the canine region with a forward and downward direction at a 30° angle to the occlusal plane. In group 2, the force was applied extraorally 20 mm above the maxillary occlusal plane. In both groups a unilateral 500 g force was applied and the patients were instructed to wear the face mask for 16 h/d for the first three months and 12 h/d for the next three months. The Wilcoxon sign rank test was used to evaluate the effect of the two different face masks, and a Mann-Whitney *U*-test was carried out to evaluate the differences between the two groups. The results showed that both force systems were equally effective to protract the maxilla; however, in group 1 we observed that the maxilla advanced forward with a counter-clockwise rotation. In group 2 we observed an anterior translation of maxilla without rotation. The dental effects of both methods were also different. The maxillary occlusal plane did not rotate in group 1, in contrast to the clockwise rotation in group 2. The maxillary incisors were proclined slightly in group 1, but in contrast they were retroclined and extruded in group 2. In conclusion, the force application from near the center of resistance of the maxilla was an effective method to prevent the unwanted side effects, such as counter-clockwise rotation of the maxilla, in group 1. The group 2 results suggest that this method can be used effectively on patients who present as class III combined with an anterior open bite. (*Angle Orthod* 2002;72:387–396.)

Key Words: Class III; Maxillary retrognathia; Face mask; Protraction headgear; Biomechanics

INTRODUCTION

The incidence of skeletal class III malocclusion is rather small in the population, but it is one of the most difficult malocclusions to treat. Class III malocclusions are often seen with maxillary retrognathia, mandibular prognathia, or a combination of both. According to Ellis and McNamara[1] and Sue et al,[2] maxillary retrognathism is present in 62% to 67% of all class III patients, making the face mask one of the main treatment modalities in class III maxillary retrognathic preadolescent and adolescent patients.

Many investigators have reported on the results of maxillary retrognathic patients treated with face masks.[3–32] The majority of these studies noted a counterclockwise rotation of the maxilla with the protraction headgear treatment.[14–17,27,32–41] Although this rotation was a benefit in the treatment of low-angle, deep-bite class III patients, it is not indicated in class III cases with high-angle skeletal patterns and anterior open bites. In order to eliminate these unwanted side effects,[20,42–44] some investigators have applied the protraction force at an angle of 30° downward from the occlusal plane. Other investigators have assessed the effects of force application using different points of force application for maxillary protraction. They experimented with applying the force from the buccal area of the molar, canine, and lateral incisor region while still applying the force close to the level of the occlusal plane.[14,20,36,37,42,44,45–48]

Some investigators tried to pinpoint the center of resistance of the maxilla in order to find better ways of con-

[a] Associate Professor, Department of Orthodontics, Marmara University, Istanbul, Turkey.
[b] Postgraduate student, Department of Orthodontics, Marmara University, Istanbul, Turkey.
[c] Professor and Head, Department of Orthodontics, Marmara University, Istanbul, Turkey.
[d] Professor and Head, Department of Orthodontics, University of Connecticut Health Center, Farmington, Conn.
Corresponding author: Dr. Ahmet Keles, Halaskargazi Cad. Halas Apt. 275/4, Osmanbey 80220 Istanbul, Turkey
(e-mail: keles@ortodonti.com).

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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.

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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.

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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

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John Daskalogiannakis, DDS, MSc

Glossary of Orthodontic Terms

Editorial Board:
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DYNAMICS of Orthodontics

The Zygoma Anchorage System

HUGO DE CLERCK, DDS, PHD
VIRGINIE GEERINCKX, DDS
SERGIO SICILIANO, MD, DDS

Fixed appliance treatment of Class II malocclusions often requires intrusion and retraction of the anterior segment, which, in turn, usually necessitate mechanical reinforcement of posterior anchorage.[1] Intraoral devices such as transpalatal bars or Nance appliances[2] can reduce the need to wear Class II elastics, but can cause mesial movement of the lower first molars and protrusion of the incisors. Additional extraoral anchorage in the form of headgear[3,4] is often rejected by adult patients for social and professional reasons. Even when headgear is worn 14 hours a day, some anchorage loss and mesial movement of the upper molars are usually observed.

Osseointegrated titanium implants have recently been used to enhance orthodontic anchorage without the need for special patient compliance.[5] After orthodontic treatment, these implants can be used to replace one or more missing teeth.[6] Removable implants have also been placed distal to the molars to close first molar extraction spaces[7] and prevent tipping of the second and third molars. These implants are unpredictable, however, because their relationship to the adjacent teeth and the occlusion changes considerably during treatment.

The thickness of the anterior midpalatal bone allows a more stable implant to be placed there,[8,9] and a rigid appliance can be connected from the central implant to the first premolars or molars.[10] Because the transpalatal arch must be as rigid as possible, however, the amount of anchorage cannot be adjusted during treatment. The reaction forces generated during intrusion of the anterior teeth are first applied to the upper molars and then transmitted to the implant by the transpalatal arch, making the implant system an indirect anchorage unit. Because of osseointegration and the large diameter of the implant, a hollow explantation drill must be used to remove the implant at the end of treatment, leaving a bone cavity with a diameter of about 5mm. Some authors advise leaving the subgingival part of the implant in the bone permanently.

Miniscrews are small enough to be placed between the roots of the teeth in the alveolar bone.[11-14] By connecting two or more miniscrews, the orthodontic reaction forces can be neutralized. The surgical procedure is uncomplicated because the screws are placed directly through the gingiva, without a mucoperiosteal flap, and can be loaded immediately after insertion. Miniscrews can be used in the anterior or posterior region and attached with elastics or coil springs to the fixed appliance for direct anchorage. Anchorage can be adapted to changing treatment needs in different parts of the dental arches.

Dr. De Clerck is Head and Dr. Geerinckx is a postgraduate student, Department of Orthodontics, and Dr. Siciliano is a consultant, Department of Oral and Maxillofacial Surgery, Catholic University of Louvain, St. Luc University Hospital, 15, Av. Hippocrates, 1200 Brussels, Belgium. E-mail Dr. De Clerck at hugo.declerck@advalvas.be.

Dr. De Clerck

Dr. Geerinckx

Dr. Siciliano

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.
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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

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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*

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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

Success rate of miniplate anchorage for bone anchored maxillary protraction

Eline E. B. De Clerck[a]; Gwen R. J. Swennen[b]

ABSTRACT

Objective: To evaluate the success rate of Bollard miniplate anchorage for bone anchored maxillary protraction (BAMP).

Materials and Methods: Twenty-five consecutive patients (mean age, 12.0 ± 1.2 years; range, 8.7–14.8 years) with maxillary hypoplasia without congenital or acquired deformation were included in this study. A total of 100 Bollard modified miniplates were placed by the same surgeon. Ninety-nine miniplates were inserted under general anesthesia, and one was placed under local anesthesia because of initially soft bone conditions. Loading of the miniplates with 150 g elastics was initiated at 17.5 ± 6.9 days (range, 11–38 days) after surgery. Mean follow-up was provided at 20.8 ± 11.1 months (range, 6.5–46.2 months).

Results: The overall success rate of miniplate anchorage in terms of stability was 97%. During orthodontic loading, five miniplates showed signs of mobility. After interruption of loading over 2 months, two miniplates became stable again. However, a total of three miniplates needed to be removed and were successfully replaced under local anesthesia after a mean healing period of 3 months.

Conclusion: Skeletal anchorage by means of Bollard modified miniplates is effective for BAMP. Success depends on proper presurgical patient counseling, minimal invasive surgery, good postsurgical instructions, and orthodontic follow-up. (*Angle Orthod.* 2011;81:1010–1013.)

KEY WORDS: Miniplate anchorage; Bone anchored maxillary protraction; Success rate

INTRODUCTION

Correction of maxillary hypoplasia during growth by orthopedic maxillary protraction was pioneered by Delaire in the 1970s.[1,2] The main disadvantages of Delaire face mask therapy are noncompliance due to discomfort, dentoalveolar compensation, and clockwise rotation of the mandible.[3–6] To reduce these side effects, modified methods of maxillary protraction were developed consisting of (1) maxillary distraction by a rigid external distractor[7–12]; (2) maxillary distraction with a face mask after Le Fort I corticotomy in cleft patients[13–15]; and (3) face mask combined with skeletal anchorage in the upper jaw.[16–18] The first two modified methods of maxillary protraction involved Le Fort I corticotomy or osteotomy; the two latter protocols still involved the use of a face mask.

Over several years, bone anchored maxillary protraction (BAMP) without corticotomy or osteotomy with the use of class III elastics between miniplate skeletal anchorage in the upper and lower jaw was introduced.[19,20] With this approach, an extraoral face mask is no longer needed and intermaxillary traction can be applied 24 hours a day. Preliminary studies based on conventional two-dimensional (2D) cephalometric analysis[21,22] and three-dimensional (3D) virtual treatment outcome analysis[23] showed already very promising results. However, the stability and success rate of miniplate anchorage for BAMP had not been investigated yet. Hence, the aim of this prospective study was to evaluate the success rate of Bollard miniplate anchorage for BAMP in growing children.

MATERIALS AND METHODS

This prospective study was approved by the Institutional Review Board of the AZ St-Jan Hospital. A total of 25 consecutive patients were included. All patients were referred for BAMP by four different orthodontists (L.G.: n = 4; T.B.: n = 1; V.G.: n = 1;

[a] Medical student, Katholieke Universiteit Leuven, Belgium; research assistant, Division of Maxillo-Facial Surgery, Department of Surgery, General Hospital St-Jan Bruges, Rudershove, Bruges, Belgium.

[b] Professor, Division of Maxillo-Facial Surgery, Department of Surgery, General Hospital St-Jan Bruges, Bruges, Belgium.

Corresponding author: Professor Gwen R. J. Swennen, MD, LDS, DMD, PhD, FEBOMFS, Division of Maxillo-Facial Surgery, Department of Surgery, General Hospital St-Jan Bruges, Rudderschove 10, 8000 Bruges, Belgium
(e-mail: gwen.swennen@azsintjan.be)

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RANDOMIZED CONTROLLED TRIAL CE AJO-DO

Effect of maxillary protraction with alternating rapid palatal expansion and constriction vs expansion alone in maxillary retrusive patients: A single-center, randomized controlled trial

Weitao Liu,[a] Yanheng Zhou,[b] Xuedong Wang,[a] Dawei Liu,[a] and Shaonan Zhou[c]
Beijing, China

Introduction: The objective of this randomized controlled trial was to investigate the effects of facemask protraction combined with alternating rapid palatal expansion and constriction (RPE/C) vs rapid palatal expansion (RPE) alone in the early treatment of maxillary retrusive patients. **Methods:** Patients with a midface deficiency were recruited and randomly allocated into either the control group (RPE) or the intervention group (RPE/C). Eligibility criteria included the following: age 7 to 13 years old, Class III malocclusion, anterior crossbite, ANB less than 0°, Wits appraisal less than −2 mm, A-Np less than 0 mm, and no cleft of lip or palate. The primary outcome was the degree of maxillary forward movement after treatment. The secondary outcomes were the changes of the other cephalometric variables after treatment and the treatment time. Simple randomization was carried out using a random number table at the beginning of the study. Envelopes containing the grouping information were used to ensure allocation concealment from the researchers. Blinding was applicable for cephalometric analysis only. Hyrax palatal expanders and facemask maxillary protraction were used in all patients. Patients in the RPE group were treated with rapid palatal expansion for 1 week. Patients in the RPE/C group were treated with RPE/C for 7 weeks. The expansion or constriction rate was 1 mm per day. Cephalometric analysis with traditional cephalometric measurements and an x-y coordinate system were used to compare the pretreatment and posttreatment cephalometric radiographs. Independent *t* tests were used to compare the data between the 2 groups. **Results:** A total of 44 patients were randomized to either the RPE group or the RPE/C group in a 1:1 ratio. One subject in the RPE group was lost to follow-up during the treatment. Per-protocol analysis was used. All the other 43 patients reached the treatment completion criteria and were analyzed (RPE group: n = 21; RPE/C group: n = 22). The average protraction time was 10.84 months in the RPE group, which was significantly longer than that in the RPE/C group (9.06 months) (effect size [ES], 1.78 [95% CI, 0.15, 3.42; $P = 0.033$]). Maxillary forward movement increased by 3.04 mm in the RPE/C group, which was significantly greater than that in the RPE group (2.11 mm) (ES, −0.93 [95% CI, −1.65, −0.20; $P = 0.013$]). The counterclockwise rotation of the palatal plane was 1.73° in the RPE/C group, which was significantly greater than that in the RPE group (0.83°) (ES, 0.90 [95% CI, 0.08, 1.73; $P = 0.033$]). The degree of mandibular downward and backward rotation was significantly smaller in the RPE/C group ($P < 0.05$). No serious harm was observed during treatment and research. **Conclusions:** Facemask maxillary protraction with RPE/C might positively affect the forward movement of the maxilla compared with facemask protraction with RPE alone in the early treatment of maxillary retrusive patients. Although the differences between the groups were statistically significant for forward movement of the maxilla and rotation of the palatal and mandibular planes, these may not be clinically relevant, since the differences were less than 1 mm and 1°, respectively. **Registration:** This trial was not registered. **Protocol:** The protocol was not published before trial commencement. **Funding:** This research was supported by Peking University Research Fund. No conflict of interest is declared. (Am J Orthod Dentofacial Orthop 2015;148:641-51)

From the Department of Orthodontics, Peking University School and Hospital of Stomatology, Beijing, China.
[a]Assistant professor.
[b]Professor and chair.
[c]Resident.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

Address correspondence to: Yanheng Zhou, Department of Orthodontics, Peking University School and Hospital of Stomatology, 22 Zhongguancun South Avenue, Beijing 100081, China; e-mail, yanhengzhou@gmail.com.
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MINI-IMPLANT SUPPLEMENT

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The Hybrid Hyrax Distalizer, a new all-in-one appliance for rapid palatal expansion, early class III treatment and upper molar distalization

Benedict Wilmes[1], Björn Ludwig[2], Vandana Katyal[3], Manuel Nienkemper[1], Anna Rein[1] and Dieter Drescher[1]

[1]Department of Orthodontics, University of Duesseldorf, Duesseldorf, Germany; [2]Private Office Am Bahnhof 54, Traben-Trarbach, Germany; [3]Australian Society of Orthodontist Foundation For Research and Education, Sydney, Australia

Growing class III patients with maxillary deficiency may be treated with a maxillary protraction facemask. Because the force generated by this appliance is applied to the teeth, the inevitable mesial migration of the dentition can result in anterior crowding, incisor proclination and a possible need for subsequent extraction therapy. The Hybrid Hyrax appliance, anchored on mini-implants in the anterior palate, can be used to overcome these side-effects during the facemask therapy. In some class III cases, there is also a need for subsequent distalization after the orthopaedic treatment. In this paper, clinical application of the Hybrid Hyrax Distalizer is described, facilitating both orthopaedic advancement of the maxilla and simultaneous orthodontic distalization of the maxillary molars.

Key words: Class III malocclusion, protraction facemask, hybrid hyrax, rapid maxillary expansion, mini-implant anchorage

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Introduction

A class III relationship may be caused by a retrognathic maxilla, a prognathic mandible or both (Litton *et al.*, 1970; Proffit *et al.*, 1998). Growing patients with a maxillary deficiency may be treated with a maxillary protraction device, namely the facemask. However, because the force is applied to the teeth, the inevitable mesial migration of the dentition can result in anterior crowding, incisor proclination and the possible need for a subsequent extraction therapy (Williams *et al.*, 1997). Furthermore, the desired positive skeletal effect of this approach can often turn out to be less than expected (Williams *et al.*, 1997; Ngan *et al.*, 1998). To overcome these problems, different kinds of anchorage reinforcement have been used to transfer the force directly to the maxillary bone by utlizing: ankylosed teeth (Kokich *et al.*, 1985), dental implants (Henry, 1999) and surgical mini-plates (Kircelli and Pektas, 2008; De Clerck *et al.*, 2010; Kaya *et al.*, 2011; Sar *et al.*, 2011). To minimize surgical invasiveness, Wilmes and colleagues introduced the Hybrid Hyrax (Wilmes *et al.*, 2008; Wilmes and Drescher, 2008; Wilmes *et al.*, 2009; Ludwig *et al.*, 2010; Wilmes *et al.*, 2010; Wilmes *et al.*, 2011), which uses two mini-implants in the anterior palate to provide sagittal skeletal anchorage and avoid mesial migration of the maxillary dentition (Wilmes *et al.*, 2010; Nienkemper *et al.*, 2013). These mini-implants serve as an anterior skeletal anchorage unit, whilst deciduous or permanent molars are used as posterior dental anchorage (hybrid anchorage). It is recommended that these mini-implants are used with abutments to obtain a stable coupling between them and the wires of the Hybrid Hyrax expansion appliance.

To increase advancement of the maxilla, facemask therapy is often combined with rapid palatal expansion (RPE) (Baccetti *et al.*, 1998), because stimulation of the midfacial sutures can be expected. Even though there is a controversy in the literature about the effectiveness of this approach, a number of authors recommend the combination of RPE and facemask to enhance maxillary advancement (Jager *et al.*, 2001). In some class III cases there may be a need for subsequent molar distalization after the orthopaedic treatment. Using a headgear for upper molar distalization may result in an unwanted orthopaedic maxillary growth inhibition. Additionally, there may be an instinctive problem associated with

Address for correspondence: Dr Benedict Wilmes, Department of Orthodontics, University of Duesseldorf, Moorenstr. 5, 40225 Duesseldorf, Germany.
Email: Wilmes@med.uni-duesseldorf.de

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Eric Liou

- Undergraduate degree in Dentistry from the School of Dentistry, Taipei Medical University, Taipei, Taiwan.
- Graduate degree from the Department of Orthodontics and Craniofacial Dentistry at Chang Gung Memorial Hospital, Taipei, Taiwan.
- Master in Surgery, University of Illinois, Chicago, USA.
- Assistant Professor and Director of the Research and Development Committee of the Faculty of Dentistry at Chang Gung Memorial Hospital, Taipei, Taiwan.
- Orthodontist at the Department of Orthodontics and Craniofacial Dentistry at Chang Gung Memorial Hospital, Taipei, Taiwan.
- President, Taiwan Association of Cleft Lip and Palate.
- Winner, Best Clinical Article, AJODO, 1998.
- 28 international publications, 5 book chapters, 132 participations in lectures and courses overseas, 5 international patents.

It's my pleasure to introduce Professor Eric Liou, from Taipei, Taiwan. He is one of the most important members of the world new generation of orthodontists, who will be in Brazil for the first time in October 2009, for a speech at the 7th Brazilian Association of Orthodontists Meeting that will be held in Brasília-DF. We first met in Dallas, in 1998, during the American Association of Orthodontists annual meeting. At that time he had just won the *Dewel Award*, given to the best clinical article of the year published at the AJODO. Since there I've followed his brilliant work, where he has accomplished several clinical and experimental researches whose results have given rise to some controversial and have generated a lot of interest at the international orthodontic community for its originality and vanguard. His fields of interest involve osteogenic distraction, skeletal anchorage and mechanisms to accelerate orthodontic movement. However, without doubt, one of the most important topics, frequently present in his presentations is the new protocol for maxillary protraction called Alt-RAMEC, used both for patients with or without cleft lip and palate. This is the subject of this interview conducted by me and by three other important Brazilian orthodontists, who have a lot of experience in rapid maxillary expansion and in the treatment of cleft lip and palate patients: Dr. Omar Gabriel da Silva Filho, Dr. Daniela Gamba Garib and Dr. Gerson Ulema Ribeiro.

Enjoy the reading!!!!

Ricardo Machado Cruz

Original Article

Opening of Circumaxillary Sutures by Alternate Rapid Maxillary Expansions and Constrictions

Yu-Chi Wang[a]; Peter M.S. Chang[b]; Eric Jein-Wein Liou[c]

ABSTRACT

Objective: To analyze quantitatively the circumaxillary suture opening after alternate rapid maxillary expansions and constrictions (Alt-RAMEC).

Materials and Methods: Twelve inbred cats were randomly grouped into two equal groups for 1 week of rapid maxillary expansion (RME) (1 mm/day) or 5 weeks of Alt-RAMEC (1 mm/day). At the end of the experiment, the craniofacial skeleton of each cat was harvested. Each circumaxillary suture was then probed at three sites with a 0.5-mm pointed periodontal probe. A smooth probing without penetration was an ineffective suture opening ($<$0.5 mm), while a probing with penetration was an effective suture opening ($>$0.5 mm). For each suture, the quantity of suture opening (%) was the effective suture opening/(effective + ineffective suture opening). The intergroup differences were analyzed by chi-square test ($P < .05$).

Results: Five weeks of Alt-RAMEC opened the circumaxillary sutures significantly more than 1 week of RME. This affected the circumaxillary sutures running coronally and articulating directly to the maxilla (56.9% vs 36.1%, $P < .001$), the sutures running sagittally, but articulating indirectly to the maxilla (94.4% vs 64.8%, $P < .001$), and the sutures running coronally, but articulating indirectly to the maxilla (58.3% vs 33.3%, $P < .01$). The sutures running sagittally were opened significantly more (94.4%–100.0%) than those running coronally (56.9%–58.3%), no matter if they articulated directly or indirectly with the maxilla.

Conclusions: Alt-RAMEC opens both the sagittally and coronally running circumaxillary sutures quantitatively more than conventional RME. However, more than 5 weeks of Alt-RAMEC would be needed to increase the opening of the coronally running circumaxillary sutures. (*Angle Orthod.* 2009:79;)

KEY WORDS: Rapid maxillary expansion; Sutures

INTRODUCTION

The combined use of rapid maxillary expansion and facemask has been a contemporary technique for the maxillary protraction in growing patients with Class III or cleft under the assumption that the rapid maxillary expansion opens the circumaxillary sutures and facilitates the maxillary protraction.[1–6] The average protraction amount by using rapid maxillary expansion and facemask protraction is 1.5–3 mm in 10 to 12 months.[7–9] However, the protraction should be more than this amount when the circumaxillary sutures are well opened. This could be because the devices are tooth-borne so that the results are mostly dental effects,[10] or the circumaxillary sutures are not opened enough.

It has been reported that the amount of maxillary protraction was 5–6 mm in 5 months under the protocol of alternate rapid maxillary expansions and constrictions (Alt-RAMEC) and was significantly more than rapid maxillary expansion.[11–14] The explanation of this result was the Alt-RAMEC opened the circumaxillary sutures more extensively than rapid maxillary expansion.[12,13] However, this assumption has not been tested. The purposes of this study were to test this hypothesis and to study quantitatively the extent of circumaxillary suture opening through an experimental model on cats.

[a] Lecturer, Department of Orthodontics and Craniofacial Dentistry, Gung Memorial Hospital, Taipei, Taiwan.

[b] Instructor, Department of Orthodontics and Craniofacial Dentistry, Gung Memorial Hospital, Taipei, Taiwan.

[c] Associate Professor, Department of Orthodontics and Craniofacial Dentistry, Gung Memorial Hospital, Taipei, Taiwan.

Corresponding author: Dr Eric Jein-Wein Liou, Department of Orthodontics and Craniofacial Dentistry, 199 Tung-Hwa North Road, Taipei, Taiwan 105
(e-mail: lioueric@ms19.hinet.net)

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Randomized controlled trial

Fixed versus removable orthodontic appliances to correct anterior crossbite in the mixed dentition—a randomized controlled trial

Anna-Paulina Wiedel* and Lars Bondemark**

*Department of Oral and Maxillofacial Surgery, Skane University hospital, Malmö, Sweden, **Department of Orthodontics, Faculty of Odontology, Malmö University, Sweden

Correspondence to: Anna-Paulina Wiedel, Department of Oral and Maxillofacial Surgery, Jan Waldenströmsg. 18, Skane University hospital, SE-205 02 Malmö, Sweden. E-mail: anna-paulina.wiedel@mah.se

Summary

Objective: To compare the effectiveness of fixed and removable orthodontic appliances in correcting anterior crossbite with functional shift in the mixed dentition.

Subjects and methods: Consecutive recruitment of 64 patients who met the following inclusion criteria: early to late mixed dentition, anterior crossbite with functional shift, moderate space deficiency in the maxilla, i.e. up to 4 mm, a non-extraction treatment plan, the ANB angle > 0 degree, and no previous orthodontic treatment. Sixty-two patients agreed to participate. The study was designed as a randomized controlled trial with two parallel arms. After written consent was obtained, the patients were randomized, in blocks of 10, for treatment either with a removable appliance with protruding springs or a fixed appliance with multi-brackets. The main outcome measures assessed were success rate, duration of treatment, and changes in overjet, overbite, and arch length. The results were also analysed on an intention-to-treat basis.

Results: The crossbite was successfully corrected in all patients in the fixed appliance group and all except one in the removable appliance group. The average duration of treatment was significantly less, 1.4 months, for the fixed appliance group ($P < 0.05$). There were significant increases in arch length and overjet in both treatment groups, but significantly more in the fixed appliance group ($P < 0.05$ and $P < 0.01$).

Conclusion: Anterior crossbite with functional shift in the mixed dentition can be successfully corrected by either fixed or removable appliance therapy in a short-term perspective.

Introduction

The prevalence of anterior crossbite has been shown to vary. In Finland, a prevalence of 2.2 per cent is reported for 5-year-old children (1). A Canadian study found that 10 per cent of 6 year olds and 12 per cent of 12 year olds had anterior crossbites (2), whereas in Germany a prevalence of 8 per cent has been reported (3). In a Swedish study, 11 per cent of school children had anterior crossbites, 36 per cent with functional shift (4).

In anterior crossbite with functional shift, inter-incisal contact is possible when the mandible is in the centric relation (pseudo class III). Correction at the mixed dentition stage is recommended in order to avoid a compromising dentofacial condition which could result in the development of a true class III malocclusion (2, 3, 5–7). Various treatment options are available, such as fixed appliances with a multi-bracket technique (5, 8–10), or removable appliances with protruding springs for the maxillary incisors (5, 6, 10). However, there is little evidence to indicate which is the more effective treatment method.

The purpose of scientific assessment of health care is to identify interventions which offer the greatest benefits for patients while utilizing resources in the most effective way. Consequently, scientific assessment should be applied not only to medical innovations but also to established methods.

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SCIENTIFIC SECTION

The effectiveness of alternating rapid maxillary expansion and constriction combined with maxillary protraction in the treatment of patients with a class III malocclusion: a systematic review and meta-analysis

Mohammed Almuzian [a,b], Elise McConnell[a], M. Ali Darendeliler[a], Fahad Alharbi[c] and Hisham Mohammed[b]

[a]Discipline of Orthodontics, School of Dentistry, Faculty of Medicine and Health, Sydney Dental Hospital, University of Sydney, Sydney, Australia; [b]Department of Orthodontics, Edinburgh dental Institute, University of Edinburgh, Edinburgh, UK; [c]Department of Preventive Dental Sciences, Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia

ABSTRACT

Objectives: To establish the effectiveness of Alternate Rapid Maxillary Expansion and Constriction combined with Protraction Facial Mask (Alt-RAMEC/PFM) approach in treating Class III growing patients compared with PFM combined with conventional Rapid Maxillary Expansion (RME/PFM).

Search sources: Unrestricted search in five electronic databases and manual searching were undertaken up to February 2018.

Data selection: Randomised clinical trials (RCTs) evaluating the effectiveness of Alt-RAMEC/PFM were selected.

Data extraction: Screening of references, data extraction and assessment of bias risk were evaluated independently by two reviewers.

Results: Five RCTs comparing the Alt-RAMEC/PFM with RME/PFM met the inclusion criteria. Small but statistically significant mean differences favouring Alt-RAMEC/PFM protocol as measured by SNA angle (1.16°; 95% CI 0.65 to 1.66), SNB angle (0.67°; 95% CI 0.32 to 1.02) and ANB angle (0.66°; 95% CI 0.08 to 1.25) were noted. Alt-RAMEC/PFM exhibited a more favourable overjet correction when compared to RME/PFM, however, differences in other dental changes were insignificant.

Conclusion: There is limited evidence with high risk of bias that Alt-RAMEC/PFM can result in a statistically significant increase in maxillary protraction compared with RME/PFM in Chinese subjects over the short-term. High-quality long-term RCTs with inclusion of patient-reported outcomes are required.

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Systematic review; meta-analysis; Alt-RAMEC; protraction facemask; palatal expansion; class III; RCTs

Introduction

The claimed benefits of rapid maxillary expansion (RME) include disarticulation of the circum-maxillary sutures and forward movement of the maxilla as a result of the palatal shelves pivoting around the pterygomaxillary junction (Haas 1970; Ngan et al. 1997; Turley 2007; Almuzian et al. 2018). However, several studies have disclosed uncertainty with regard to the clinical benefits of RME in relation to maxillary protraction (Foersch et al. 2015).

A new approach entitled 'Alternating Rapid Maxillary Expansion and Constriction (Alt-RAMEC) protocol' was introduced more than a decade ago by Erik Liou in an effort to achieve greater forward movement of the maxilla following maxillary protraction (Liou and Tsai 2005). The original Alt-RAMEC protocol involved expansion of the maxilla (1mm/day) in the first week followed by constriction (1 mm/day) in the following week. This procedure was repeated for 7–9 weeks, so as to achieve maximum disarticulation of the maxillary sutures without consequent over-expansion (Liou and Tsai 2005).

A recent systematic review (Pithon et al. 2016) found that using Alt-RAMEC/PFM protocol is effective; however, the authors did not include studies published in languages other than English which implied language-restriction in their inclusion criteria. Pithon and colleagues also included non-randomised clinical trials (Kaya et al. 2011; Al-Mozany et al. 2017) and a retrospective study (Masucci et al. 2014); while also including studies that recruited participants with cleft lip and palate (Liou and Tsai 2005). Furthermore, the authors of

CONTACT Mohammed Almuzian dr_muzian@hotmail.com Discipline of Orthodontics, School of Dentistry, Faculty of Medicine and Health, Sydney Dental Hospital, The University of Sydney, Rm2.22, Building C12, Sydney, NSW 2006, Australia

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Comparison of two protocols for maxillary protraction: bone anchors versus face mask with rapid maxillary expansion

Lucia Cevidanes[a], **Tiziano Baccetti**[b], **Lorenzo Franchi**[b], **James A. McNamara Jr**[c], and **Hugo De Clerck**[d]

[a]Assistant Professor, Department of Orthodontics, School of Dentistry, University of North Carolina, Chapel Hill, NC.

[b]Assistant Professor, Department of Orthodontics, University of Florence, Florence, Italy; Thomas M. Graber Visiting Scholar, Department of Orthodontics and Pediatric Dentistry, School of Dentistry, University of Michigan, Ann Arbor, Mich.

[c]Thomas M. and Doris Graber Endowed Professor of Dentistry, Department of Orthodontics and Pediatric Dentistry, School of Dentistry; Professor of Cell and Developmental Biology, School of Medicine; Research Professor, Center for Human Growth and Development, The University of Michigan, Ann Arbor, Mich; Private practice, Ann Arbor, Mich.

[d]Adjunct Professor, Department of Orthodontics, School of Dentistry, University of North Carolina, Chapel Hill, NC; Private practice, Brussels, Belgium.

Abstract

Objective—To test the hypothesis that there is no difference in the active treatment effects for maxillary advancement induced by bone-anchored maxillary protraction (BAMP) and the active treatment effects for face mask in association with rapid maxillary expansion (RME/FM).

Materials and Methods—This is a study on consecutively treated patients. The changes in dentoskeletal cephalometric variables from start of treatment (T1) to end of active treatment (T2) with an average T1–T2 interval of about 1 year were contrasted in a BAMP sample of 21 subjects with a RME/FM sample of 34 patients. All subjects were prepubertal at T1. Statistical comparison was performed with *t*-tests for independent samples.

Results—The BAMP protocol produced significantly larger maxillary advancement than the RME/FM therapy (with a difference of 2 mm to 3 mm). Mandibular sagittal changes were similar, while vertical changes were better controlled with BAMP. The sagittal intermaxillary relationships improved 2.5 mm more in the BAMP patients. Additional favorable outcomes of BAMP treatment were the lack of clockwise rotation of the mandible as well as a lack of retroclination of the lower incisors.

Conclusions—The hypothesis is rejected. The BAMP protocol produced significantly larger maxillary advancement than the RME/FM therapy.

Keywords

Class III malocclusion; Maxillary protraction; Bone anchors; Facial mask; Cephalometrics

Corresponding author: Dr Tiziano Baccetti, Department of Orthodontics, University of Florence, Via del Ponte di Mezzo, 46-48, Florence, Italy 50127 (t.baccetti@odonto.unifi.it).

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Treatment of Class III malocclusion using Hybrid Hyrax, Face Mask and Alt-RAMEC Protocol: A Case Report in a Latin-American patient

Robinsón-Andrés Castrillón-Marín [1], Diana-María Barbosa-Liz [2], Carlos-Martin Ardila [3]

[1] Orthodontist. Professor School of Dentistry. Universidad de Antioquia. Medellin. Colombia
[2] Orthodontist. Titular Professor. Gionorto Research Group. Department of Orthodontics. School of Dentistry. Universidad de Antioquia. Medellin. Colombia
[3] Periodontist. Ph.D in Epidemiology; Biomedical Stomatology Research Group, Universidad de Antioquia, Medellín, Colombia

Correspondence:
Calle 70 No. 52-21, Medellín, Colombia
martin.ardila@udea.edu.co

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Abstract

The management of Class III malocclusion is one of the greatest challenges of orthodontics. Current treatments offer the possibility of using direct skeletal anchorage to improve clinical outcomes. This case shows the results of using a Hyrax hybrid palatal anchorage, Alt-RAMEC (Alternate Rapid Maxillary Expansion and Contraction protocol) and a facemask to treat a maxillary hypoplasia Class III malocclusion in a Latin-American patient. The appliance design and the protocol used are widely described. Clinical and cephalometric results suggest that it is a good treatment option for this Latino patient, with moderate malocclusion and limitations in the dental anchorage.

Key words: *ALT-RAMEC, Angle Class III, malocclusion, maxillary expansion, mini-screws, orthodontic anchorage, TADs.*

Introduction

The objective of the treatment of growing patients with occlusal and skeletal Class III is to achieve a positive overjet through a combination of skeletal and dentoalveolar changes (1). Consequently, a rapid maxillary expansion (RME) with a facial mask (FM) has been commonly used (2). However, there are certain disadvantages associated to a dental anchorage device, which can cause a loss of space in the maxillary arch and prohibits the application of orthopedic force directly on the bone, limiting maxillary advancement (3).

Anchorage protocols have been developed to avoid the undesirable effects of dental anchorage, including dental implants, surgical mini-plates and ankylosed teeth (4). To minimize the invasiveness of these procedures, the Hybrid Hyrax was implemented (5), using mini-implants in the anterior region of the palate as sagittal bone support to prevent mesial migration of the maxillary dentition and to apply orthopedic force directly on the bone. Also, it was suggested the use of a protocol of alternating expansion and contraction of the palatal suture through Hyrax to potentiate the effects of maxi-

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Paediatric Orthodontics Part 4: SEC III protocol in Class III malocclusion

F. D'Apuzzo, V. Grassia, V. Quinzi*, M. Vitale, G. Marzo*, L. Perillo

Department of Surgical Sciences, C.I.R. Dental School, University of Turin, Turin, Italy. Orthodontic Program, Multidisciplinary Department of Medico-Surgical and Dental Specialties, University of Campania Luigi Vanvitelli, Napoli, Italy
**Section of Orthodontics, Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy*

e-mail: letizia.perillo@unicampania.it

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Abstract

SEC III protocol: Early treatment of dentoskeletal Class III malocclusions

The early treatment of dentoskeletal Class III malocclusion is one of the more challenging situations for orthodontists, mainly for the uncertainty of stable long-term results due to the interaction of both environmental and genetic aetiological factors. Several interceptive protocols have been proposed during the past decades. The SEC III protocol includes two occlusal acrylic Splints combined with Class III elastics and chin cup. The protocol was proposed to facilitate Class III dentoskeletal correction by eliminating the intercuspation and the tongue thrust with clockwise mandibular rotation and minimal dentoalveolar compensation. The main difference with all the other appliances is the vertical control, which is crucial in difficult cases such as hyperdivergent Class III malocclusions.

KEYWORDS Class III malocclusion, Early treatment, SEC III protocol.

Introduction

Dentoskeletal Class III malocclusions are extremely challenging, mainly for the uncertainty of stable long-term results. The aetiology of Class III malocclusion is multifactorial with interaction of both environmental and genetic aetiological factors [Cevidanes et al., 2010; Hartsfield et al., 2017; Perillo et al., 2015]. The incidence in the Caucasian population is low, between 1% and 5%; however, in the Asian populations it is higher, with a percentage varying from 9% to 19% [De Toffol et al., 2008; Perillo et al., 2013]. Currently, there are many treatment options for Class III malocclusions ranging from an interceptive treatment starting during childhood to treatments in permanent dentition with fixed appliances eventually associated with extractions and/or auxiliaries or an orthognathic surgery in adulthood [Jamilian et al., 2016; Ferro et al., 2003; Ferro et al., 2016; Perillo et al., 2016].

However, the early treatment approach of children with Class III malocclusion is suggested for several remarkable functional and aesthetical reasons, although aware of the uncertainty of the long-term results [Cordasco et al., 2014; Quinzi et al., 2018a, Paglia, 2019; Perillo et al. 2010]. Early treatment can help to promote a more favourable skeletal balance to avoid a possible worsening of the malocclusion during growth [Piancino et al., 2019; Raucci et al., 2015b]. Some of these reasons are the correction of the negative overjet, the elimination of any deflecting contact, enhancing the maxillary growth and limiting the mandibular one, the control and/or elimination of the environmental factors, i.e. an incorrect tongue position and function, and the minimisation of incisor compensation [Raucci et al., 2015b; Quinzi et al., 2018b, Grassia et al., 2015; Perillo et al., 2015]. Moreover, early treatment may also help these children to avoid psychological problems, increasing both their self-confidence and self-esteem. Thus, the treatment of growing patients with Class III malocclusion may reduce the length of the orthodontic treatment phase in permanent dentition and, even in case of failure, can lead to less invasive orthognathic surgical treatments at the end of the growth [Rosa et al., 2019; Quinzi et al., 2019; De Toffol et al., 2008].

Over the years, many interceptive treatments for Class III patients have been presented, although most of them aim to correct the dentoskeletal Class III malocclusion not only through sagittal skeletal changes associated with some dental compensation, but also with a compensative clockwise mandibular rotation. However the literature is scarce of long-term outcomes for many of the proposed options [Chatzoudi et al., 2014; Gazzani et al., 2018; Jamilian et al., 2016; Maspero et al., 2012; Perillo et al., 2016].

The purpose of this paper is to describe a valid orthopaedic approach, named SEC III protocol, in which the main difference with the other appliances is the vertical control, crucial in the most difficult cases such as the hyperdivergent Class III malocclusions [Ferro et al., 2003; Perillo et al., 2015].

SEC III protocol

The SEC III protocol entails two occlusal splints with Class III elastics and chin cup (Fig. 1). The objective is to facilitate

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Stability of rapid maxillary expansion and facemask therapy: A long-term controlled study

Caterina Masucci,[a] Lorenzo Franchi,[b] Efisio Defraia,[c] Manuela Mucedero,[d] Paola Cozza,[e] and Tiziano Baccetti[b]
Florence and Rome, Italy

Introduction: The aim of this prospective controlled study was to evaluate the long-term effects of rapid maxillary expansion and facemask therapy in Class III subjects. **Methods:** Twenty-two subjects (9 boys, 13 girls; mean age, 9.2 years ± 1.6) with Class III disharmony were treated consecutively with rapid maxillary expansion and facemask therapy followed by fixed appliances. The patients were reevaluated at the end of the 2-phase treatment (mean age, 14.5 years ± 1.9) and then recalled about 8.5 years after the end of rapid maxillary expansion and facemask treatment (mean age, 18.7 years ± 2.1). Two groups of controls with untreated Class III malocclusion were used for statistical comparisons of the short-term and long-term intervals. Statistical comparisons were performed with the Mann-Whitney U test. **Results:** In the long term, no significant differences in maxillary changes were recorded, whereas the treatment group showed significantly smaller increases in mandibular protrusion. The sagittal maxillomandibular skeletal variables maintained significant improvements in the treatment group vs the control groups. **Conclusions:** In the long term, rapid maxillary expansion and facemask therapy led to successful outcomes in about 73% of the Class III patients. Favorable skeletal changes were mainly due to significant improvements in the sagittal position of the mandible. (Am J Orthod Dentofacial Orthop 2011;140:493-500)

Rapid maxillary expansion and facial mask (RME/FM) therapy is the most common orthopedic treatment protocol for Class III malocclusion.[1,2] The literature includes many articles on the short-term results of RME/FM therapy in growing subjects with Class III disharmonies, as described in a recent systematic review.[3] Several studies have also evaluated the outcomes of the orthopedic treatment protocol at postpubertal observations after fixed appliance therapy, either with[4] or without[5,6] untreated Class III controls. Both short-term and postpubertal observations indicated a fair-to-good effectiveness of RME/FM therapy, with about 70% to 80% of the patients showing favorable results after puberty. The dentoskeletal changes induced by therapy consist of a combined effect of the protocol on both maxillary and mandibular components. Optimal timing for the orthopedic approach to Class III malocclusion is related to early treatment, at either a prepubertal or a pubertal phase of development.[7]

No data are available in the literature with regard to the outcomes of RME/FM therapy revaluated at the end of active craniofacial growth—ie, after the circumpubertal developmental period. This information is vital for the appraisal of orthopedic treatment results in patients with Class III malocclusion for at least 2 main reasons. First, a significant tendency for the reestablishment of the Class III growth pattern has been widely demonstrated after active protraction therapy, with special emphasis during the pubertal growth spurt.[4,8-10] Second, pubertal growth tends to last longer in Class III subjects compared with Class I subjects.[11] On the other end, long-term observations at the end of active craniofacial growth are available for different orthopedic and orthodontic approaches: chincup therapy, with favorable short-term changes often not maintained at the end of growth,[12] and mandibular cervical headgear, with greater long-term stability of favorable mandibular modifications.[13]

The aim of this study was to analyze the long-term outcomes of RME/FM therapy in Class III subjects. The

[a]Research associate, Department of Orthodontics, University of Florence, Florence, Italy.
[b]Assistant professor, Department of Orthodontics, University of Florence, Florence, Italy; Thomas M. Graber Visiting Scholar, Department of Orthodontics and Pediatric Dentistry, School of Dentistry, University of Michigan, Ann Arbor.
[c]Associate professor and department chair, Department of Orthodontics, University of Florence, Florence, Italy.
[d]Research fellow, Department of Orthodontics, University of Rome Tor Vergata, Rome, Italy.
[e]Professor and department chair, Department of Orthodontics, University of Rome Tor Vergata, Rome, Italy.
The authors report no commercial, proprietary, or financial interest in the products or companies described in this article.
Reprint requests to: Tiziano Baccetti, Department of Orthodontics, University of Florence, Via del Ponte di Mezzo, 46-48, Florence, Italy 50127; e-mail, tbaccetti@unifi.it.
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