CHAPTER 15

The LOMAS System

Eric J. W. Liou, James C. Y. Lin

THE LOMAS SYSTEM

An ideal orthodontic miniscrew should be applicable to all orthodontic anchorage requirements, capable of withstanding the forces applied without the risk of fracture, loadable during the entire treatment period, and easily used in all mechanics situations. In addition, the miniscrew should be compatible with the standard orthodontic edgewise appliance, which requires it to function like a bracket, a tube, and a hook so that arch wires, elastics, and coil springs can be attached.

The Lin/Liou Orthodontic Mini Anchor System (LOMAS, Mondeal Medical System Gmbh, Tuttlingen, Germany)[1,2] was developed to fulfill the ideal criteria (Fig. 15-1). The LOMAS miniscrew is a self-drilling and self-tapping orthodontic miniscrew that can be used for direct osseous orthodontic anchorage within the dental arches interradicularly and in non–tooth-bearing areas. The LOMAS miniscrew implant (MSI) is made of titanium alloy, which provides increased tensile and compressive strength for the self-drilling and heavy orthodontic forces.[3] The anatomic design of the LOMAS miniscrew consists of a threaded body, a transmucosal collar or platform, and an abutment head (Fig. 15-2).

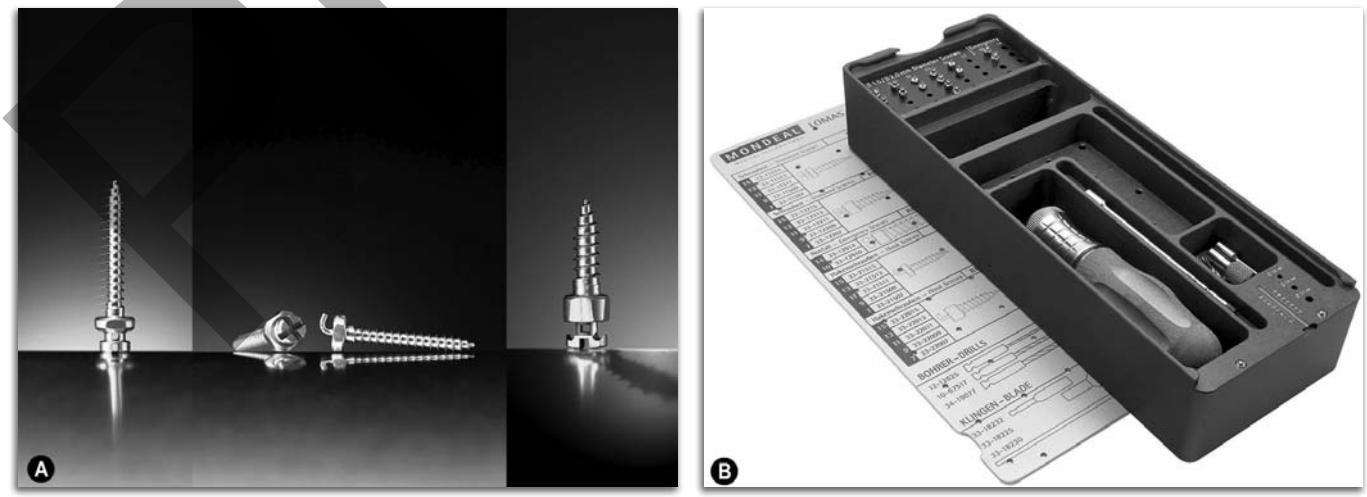

Fig. 15-1

Lin/Liou Orthodontic Mini Anchor System (LOMAS). **A,** Three different head designs. **B,** Surgical kit.

Threaded Body

The threaded body has a sharp cutting tip for self-drilling, a tapered shape for self-tapping, and deeper thread depth for better mechanical retention and decreased failure.[4] The LOMAS miniscrew comes in three lengths (7, 9, and 11 mm) and three diameters (1.5, 2.0, and 2.7 mm) for different locations within the oral cavity (Table 15-1). The 1.5-mm diameter LOMAS miniscrew is designed for use in interdental areas. The 7-mm length is used anteriorly and 9-mm length posteriorly. The force level should not exceed 200 g. The 2.0-mm diameter LOMAS miniscrew is designed for use in non–tooth-bearing areas (Fig. 15-3), such as the infrazygomatic crest of the maxilla or the mandibular external oblique ridge (buccal shelf). In the infrazygomatic crest the 9- or 11-mm lengths are used, whereas in the external oblique ridge the 7- or 9-mm lengths are used. The force level can be as high as 400 to 600 g. The 2.7-mm diameter LOMAS miniscrew is the emergency MSI in case the 2.0-mm diameter LOMAS miniscrew fails. The miniscrew should be placed only in a non–tooth-bearing area or edentulous alveolar ridge. The force level can be higher than 600 g.

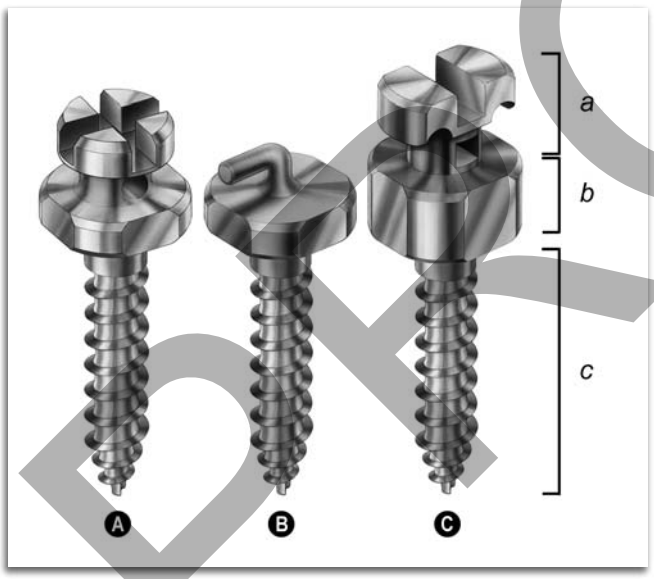

Fig. 15-2

Anatomy of LOMAS miniscrews. **A,** Standard head. **B,** Hook head. **C,** Quattro head. Abutment head *(a),* transmucosal collar *(b),* and threaded body *(c).*

Transmucosal Collar

The transmucosal collar or platform is the component that lies between the threaded body and the abutment head and abuts against the outer cortical bone. The collar emerges through the soft tissue, and its thickness elevates the abutment head to prevent soft tissue impingement from elastics or coil springs. The collar comes in two thicknesses: the *flat* platform is 1 mm tall (Fig. 15-2, *A* and *B*), and the *regular* platform is 2 mm tall (Fig. 15-2, *C*) for the different MSI sites (Table 15-1). The 1.5-mm diameter miniscrew has the flat platform for use in interdental areas. The 2.0- and 2.7-mm diameter miniscrews have the regular platform for use in non–tooth-bearing areas.

Abutment Head

Three different abutment heads are available: the *standard,* the *hook,* and the *Quattro* (Fig. 15-2). All are compatible with the traditional orthodontic edgewise appliance. The *standard* miniscrew has an 0.022 × 0.028-inch bracket slot and an 0.8-mm round auxiliary tube. The bracket slot is for placement of orthodontic arch wires; the round auxiliary tube is for the ligation of elastics, ligature wires, or coil springs or for the insertion of an auxiliary arch wire. The *hook* miniscrew has an inverted L-shaped hook for easy application of elastics or coil springs (Fig. 15-4, *A*). The Quattro miniscrew has an 0.018 × 0.025-inch or 0.022 × 0.028-inch Lewis-type bracket for arch wire placement. The Quattro miniscrew also has a rectangular auxiliary tube for insertion of an auxiliary rectangular arch wire (Fig. 15-4, *B*). The bracket wings have undercuts for ligation of arch wires with elastic or stainless steel ligatures or for attachment of elastics.

TREATMENT PLANNING

The incorporation of miniscrews as osseous anchorage has greatly broadened the spectrum of orthodontic treatment.[5] This does not mean, however, that miniscrews should be used routinely in every case and without regard for sound diagnosis and treatment planning. When using miniscrews, one should consider certain guidelines. Because anchorage is no longer an issue, treatment should be planned as though patient

Table 15-1 LOMAS Miniscrew Implant (MSI) Dimensions and Locations

Diameter (mm)	Platform (mm)	Length (mm)	MSI Sites	Loading Force (g)
1.5	1.0	7, 9, 11	Interdental areas	<200
2.0	2.0	7, 9, 11	Non–tooth-bearing areas	<400-600
2.7	2.0	7, 9, 11	Emergency	<600-800

Fig. 15-3

Placement location of LOMAS miniscrews in maxillary infrazygomatic crest and mandibular external oblique ridge.

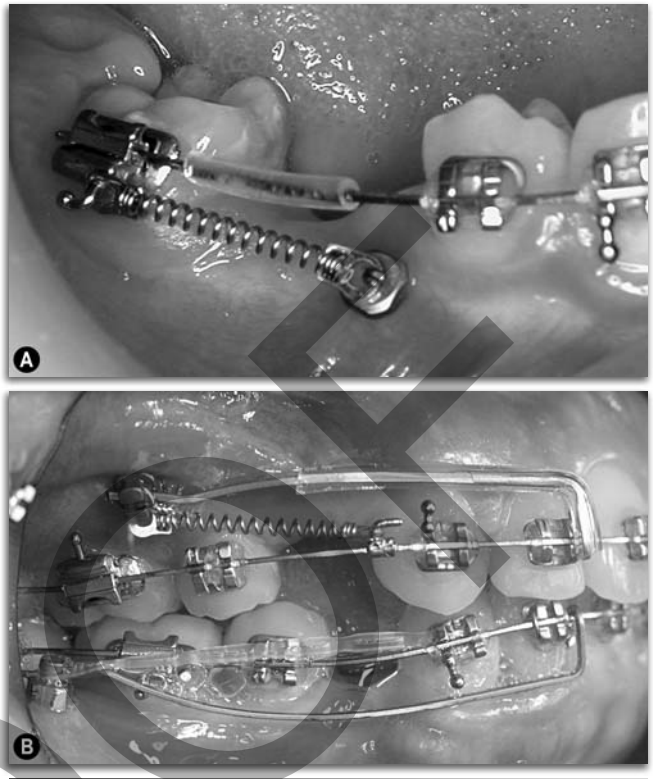

Fig. 15-4

LOMAS attachment mechanics. **A,** LOMAS hook miniscrew allows direct attachment of NiTi closed coil springs. **B,** LOMAS Quattro miniscrew allows attachment of lever arms, elastic modules, and NiTi closed coil springs.

compliance were perfect or as if the case were being set up for jaw surgery. However, the planned tooth movement still should be within the boundaries of the biologic system.

The length and width of the alveolar ridge limits the possible tooth movements regardless of what is possible with miniscrew anchorage. For distalization or retraction of maxillary teeth, the boundaries are the palatal cortical plate and the posterior wall of the maxillary tuberosity. For distalization or retraction of mandibular teeth, the boundaries are the lingual cortical plate of the alveolar ridge and the ascending ramus. For maxillary intrusion, the boundaries are the floors of the nasal cavity and maxillary sinus.

Although interdental implant sites are easier to access, they are indicated only when teeth adjacent to the miniscrew are not to be moved mesiodistally. For example, the placement of a 1.5-mm LOMAS miniscrew between the maxillary posterior teeth in a Class II case would be contraindicated if the teeth are planned to be distalized (Fig. 15-5, *A*).

The selected interdental site should be wider than 5.5 mm mesiodistally. This is based on the fact that an orthodontic miniscrew might migrate in bone and contact the tooth roots under heavy orthodontic forces. At least a 2-mm zone of clearance should be maintained between the miniscrew and the tooth roots to prevent the possibility of tooth root damage during surgical miniscrew placement or orthodontic tooth movement.[6,7] Therefore, when a 1.5-mm diameter LOMAS miniscrew is used, the interseptal bone width should be at least 5.5 mm (2.0 mm + 1.5 mm + 2.0 mm; Fig. 15-6).

The apical third of the interseptal bone is always wider mesiodistally than the middle or gingival third. The LOMAS miniscrew should be placed as close to the apical third as possible. The most frequent site in the maxilla and mandible is the apical third of the interseptal bone between the first molar and second premolar where the width is usually wider than 5.5 mm.

The non–tooth-bearing areas are universal MSI sites regardless of whether the posterior teeth are planned to be moved mesiodistally. For example, a 2.0-mm LOMAS miniscrew can be inserted into the infrazygomatic crest for en masse retraction of the entire maxillary dentition in a Class II nonextraction case or for maxillary anterior retraction in a Class II extraction case (Fig. 15-5, *B*).

The most frequent non–tooth-bearing MSI sites for the LOMAS miniscrews are the infrazygomatic crest

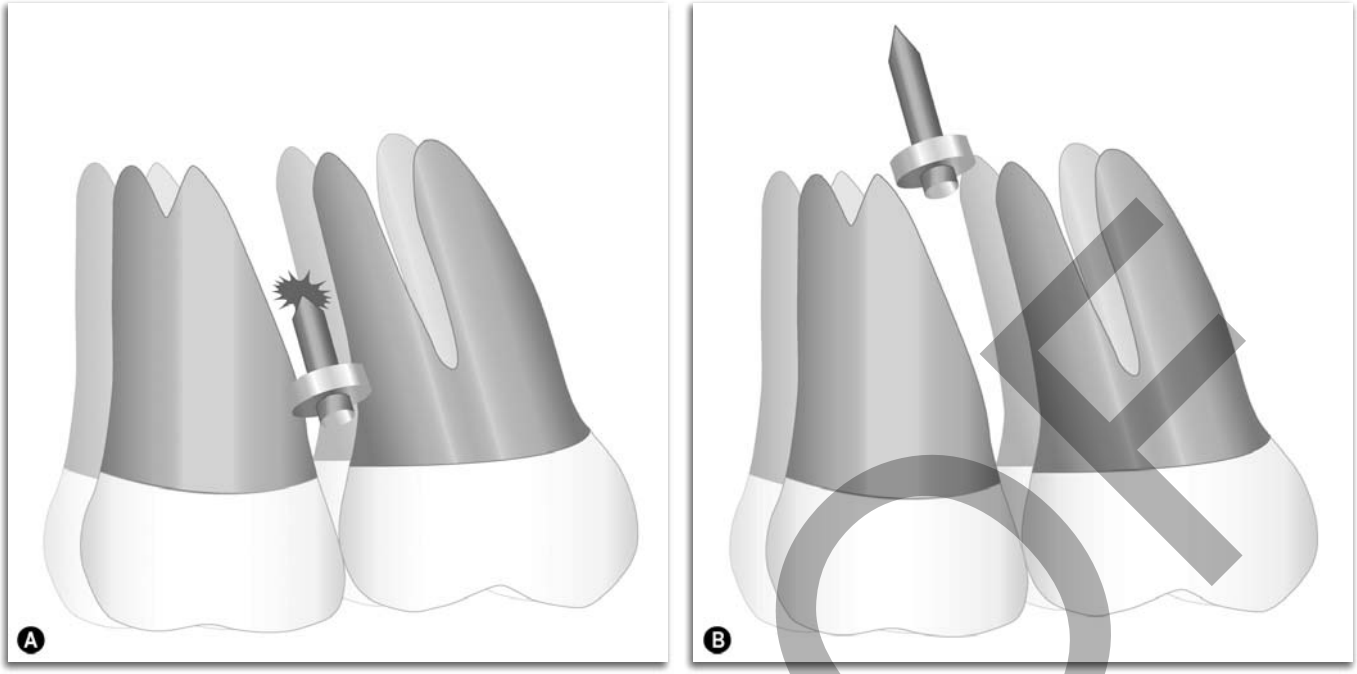

Fig. 15-5

Diagnostic decision for interradicular LOMAS miniscrew placement. **A,** When moving teeth mesiodistal, there is an increased risk of moving the teeth into the miniscrew when it is placed interradicularly. **B,** When moving teeth mesiodistal, there is little risk of moving the teeth into the miniscrew when placed in the infrazygomatic crest.

and the external oblique ridge and can be used as anchorage sites for canine retraction, anterior retraction, anterior en masse retraction, and posterior intrusion.[8-14] The paramedian hard palate, subanterior nasal spine region, maxillary tuberosity, mandibular symphysis, and retromolar area are also feasible sites for LOMAS miniscrews anchorage.[2]

PRESURGICAL ORTHODONTICS

When interdental miniscrew placement sites are planned, presurgical orthodontics are required to align the dentition and tooth roots to at least a 0.016 × 0.022-inch stainless steel arch wire and to maximize the amount of interradicular bone in the apical third to at least 5.5 mm. When the apical third of the planned miniscrew placement site is less than 5.5 mm after initial alignment, the miniscrew placement site should be moved to a non–tooth-bearing area so that treatment proceeds without delay. Treatment time is delayed too much when the tooth roots are diverged orthodontically before MSI placement and are again made parallel after MSI removal.

Unlike interdental MSI sites, presurgical orthodontics is not necessary when the non–tooth-bearing areas are the intended miniscrew sites. The chance of tooth root contact during placement or tooth movement is almost zero if the miniscrews are placed appropriately. Orthodontic tooth movement can be performed before, during, or after the dentition is aligned.

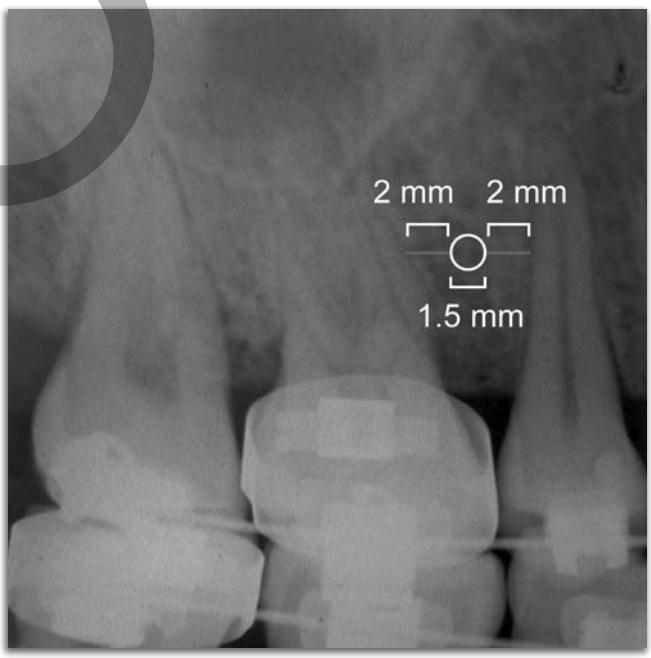

Fig. 15-6

Space requirements for a 1.5-mm diameter LOMAS miniscrew is at least 5.5 mm of interseptal bone to prevent potential tooth root contact.

SURGICAL PROCEDURE

The placement protocol for LOMAS miniscrews is referred to as the *bone density–guided insertion technique* because it is based on the bone density of the MSI site.[2,15] The bone quality is classified into four types according to its Misch bone density category.[16] Density type D1 is dense cortical bone as seen in the external oblique ridge (Fig. 15-7, *A*). D2 is porous cortical and coarse trabecular bone as seen in the infrazygomatic crest (Fig. 15-7, *B*) and interseptal bone of the mandibular posterior teeth. D3 is porous cortical and fine trabecular bone as seen in the infrazygomatic crest and the interseptal bone of maxillary and mandibular posterior teeth (Fig. 15-7, *C*). D4 is thin cortical bone with fine trabecular bone as seen in the interseptal bone of the maxillary and mandibular anterior teeth.

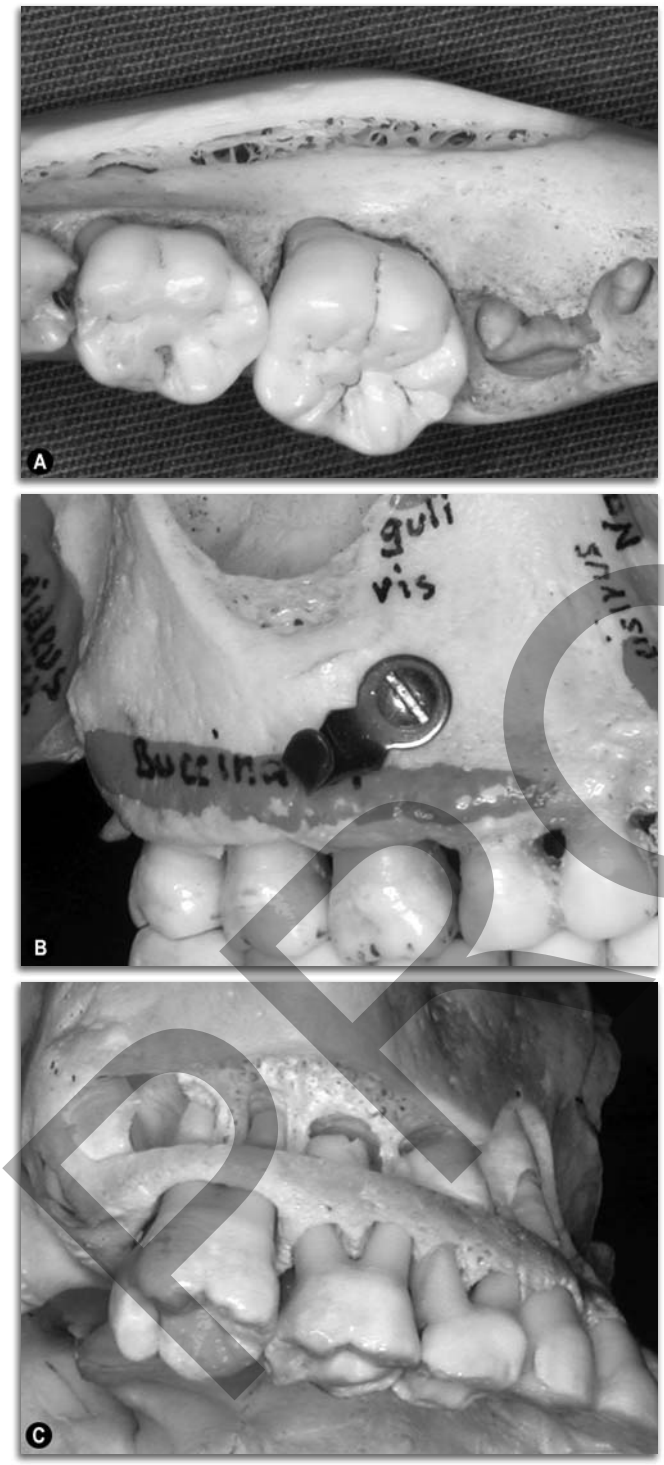

Fig. 15-7

Common sites for different bone density within the oral cavity. **A,** D1 bone is found in the mandibular external oblique ridge. **B,** D2 bone is found in the maxillary infrazygomatic crest. **C,** D3 bone is sometimes found in the infrazygomatic crest and D4 bone is found in interradicular bone.

General Guidelines for Bone Density–Guided Insertion Technique

General guidelines for bone density–guided insertion technique are as follows:

1. Standard photographs, radiographs, and computed tomographic (CT) images should be acquired of the prospective miniscrew site before the surgical procedure.
2. The LOMAS miniscrews should remain in place the shortest duration possible to achieve the desired treatment result. Therefore, the best time for LOMAS miniscrew placement is immediately before use.
3. All surgical procedures should be performed under local infiltration anesthesia; block anesthesia is not necessary.
4. The Misch bone density is established using Hounsfield

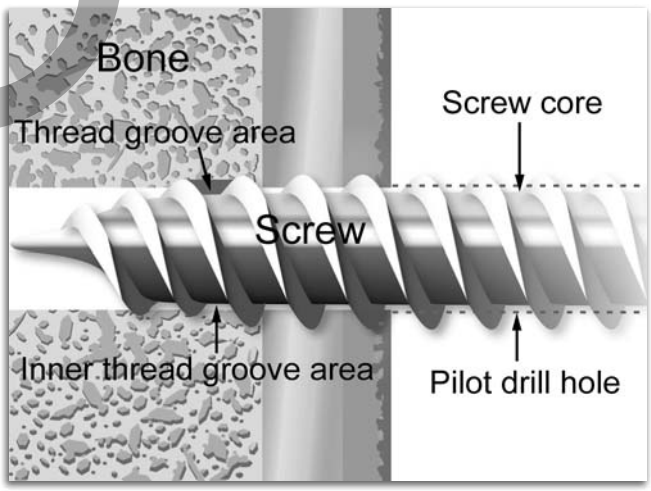

Fig. 15-8

Anatomy of threaded body and its relationship to the pilot hole, which should be 75% smaller than the threaded body diameter.

Table 15-2. CT Values of Bone Density.

Misch Bone Density	Hounsfield Units
D1	>1250
D2	850-1250
D3	350-850
D4	150-350

CT, Computed tomography.

units from the CT images[17] (Table 15-2).

5. When CT images are not available, bone density can be established by pressing a No. 15 surgical blade firmly into the cortical bone at the MSI site. If the blade cuts and makes an indention in the cortical bone surface, the bone density is D3 or D4; otherwise, the bone density is D1 or D2.
6. In D1 and D2 bone (infrazygomatic crest and external oblique ridge), a pilot hole at approximately 75% of the MSI size is drilled in the cortical bone (Fig. 15-8).[18] The drill speed should be limited to 500 to 800 rpm under sterile saline irrigation to prevent bone necrosis from overheating.[19,20]
7. In D3 and D4 bone (maxillary and mandibular interseptal bone), no pilot hole is required; the LOMAS miniscrew is placed directly with the LOMAS screwdriver.[2]
8. The emergence of the LOMAS miniscrew should be in attached gingiva or at the mucogingival junction. MSI emergence in mobile mucosa frequently causes soft tissue irritation.[21]
9. The LOMAS miniscrews can either be loaded immediately or after 2 weeks of soft tissue healing.[4]
10. Neither antibiotics nor analgesics are required postoperatively. However, 2% chlorhexidine mouth rinse is prescribed, and the patient is instructed to brush the LOMAS miniscrews gently after each meal as with normal orthodontic appliances.

Specific Guidelines for Bone Density–Guided Insertion Technique

Specific guidelines for bone density–guided insertion technique are as follows based on insertion site.

Interdental Sites

The interdental sites lie between the roots of the maxillary and mandibular teeth. Guidelines are as follows:

1. A vertical bitewing radiograph is taken of the planned interdental site. The insertion site is approximated by drawing a line along the occlusal plane and bisecting that line through the interproximal contact (Fig. 15-9, *A*).
2. The site is defined by moving from the occlusal plane along the interproximal contact line to the most coronal point that has a mesiodistal width of greater than 5.5 mm (I-point).
3. The angle of the bisecting line and the distance of the I-point from the occlusal plane is measured on the radiograph.
4. The angle between the occlusal plane and the interproximal contact line and the I-point are transferred to the patient by using a periodontal probe to penetrate through the attached gingiva or mucosa (Fig. 15-9, *B*).
5. A 1.5-mm diameter and 9-mm long LOMAS miniscrew is used for posterior teeth, and a 1.5-mm diameter and 7-mm long LOMAS miniscrew is used for anterior teeth (Fig. 15-9, *C*).

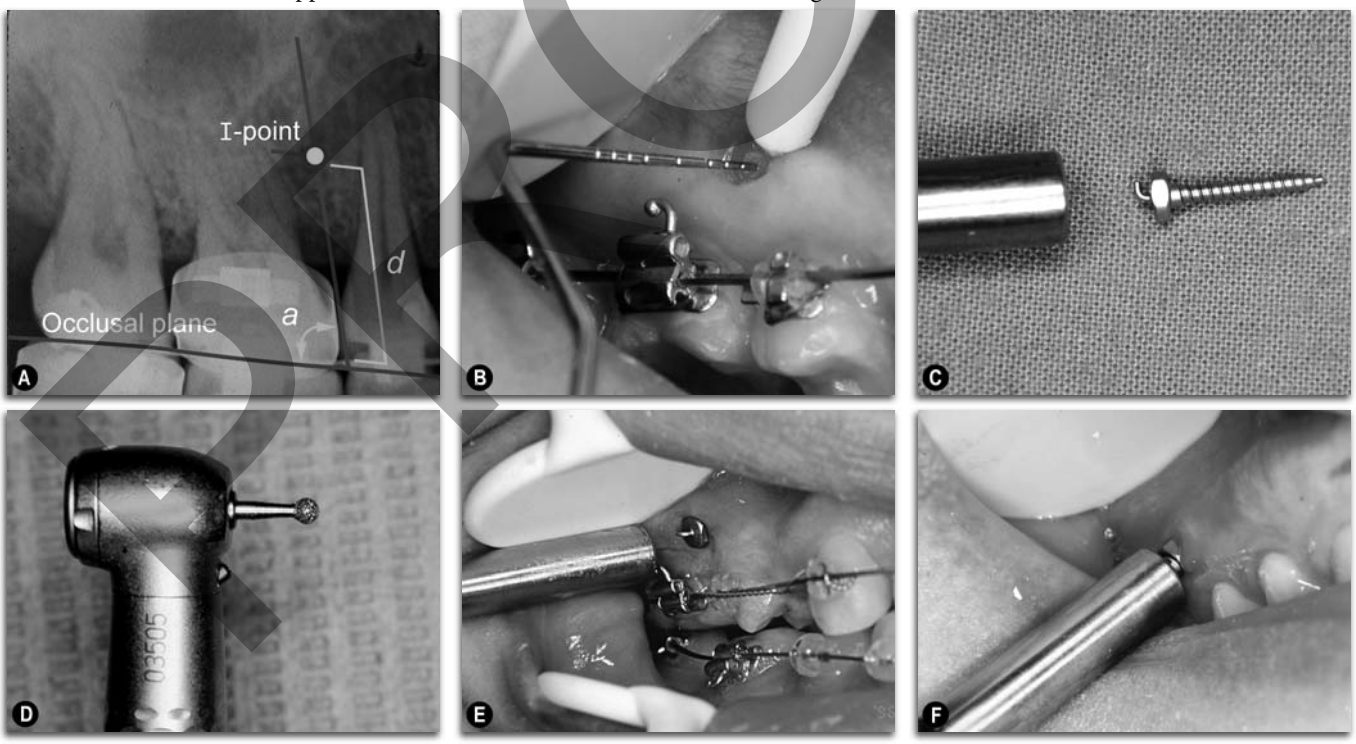

Fig. 15-9

Radiographic evaluation and surgical placement of the interradicular LOMAS miniscrew. **A,** Vertical bitewing radiograph is used to determine miniscrew position. **B,** Periodontal probe is used to transfer measurement to interproximal site. **C,** Appropriate LOMAS miniscrew is chosen. **D,** A No. 2 round diamond in a high-speed handpiece is used to remove the attached gingiva and periosteum. **E,** The LOMAS miniscrew is placed at a right angle at the I-point. **F,** The LOMAS miniscrew is placed at a 30- to 40-degree angle if the I-point is high in the vestibule.

6. When the I-point is located in attached gingiva, use a No. 2 round diamond in a high-speed handpiece to remove the attached gingiva and periosteum (Fig. 15-9, *D*). Place the selected LOMAS miniscrew at a right angle at the I-point with the LOMAS screwdriver (Fig. 15-9, *E*).
7. When the I-point is located in mobile mucosa, make a new I-point slightly below the mucogingival junction, remove the overlying attached gingiva and periosteum, and place the LOMAS miniscrew into the new I-point at a 30- to 40-degree angle relative to the occlusal plane toward the real I-point (Fig. 15-9, *F*).
8. The site and LOMAS miniscrew are irrigated thoroughly with saline.
9. Postoperative radiographs are taken.
10. The LOMAS miniscrew is loaded immediately.

Infrazygomatic Crest

The infrazygomatic crest is a bony ridge running along the curvature between the alveolar process and zygomatic process of the maxilla (Figs. 15-3 and 15-7, *B*). The thickness of the infrazygomatic crest ranges from 5.5 to 8.8 mm in adults.[22] In younger individuals, the infrazygomatic crest lies between the maxillary second premolar and first molar; in adults it lies above the maxillary first molar. Guidelines are as follows:

1. The thickness of the infrazygomatic crest and floor of the maxillary sinus is evaluated on the posteroanterior cephalometric and panoramic radiographs (Fig. 15-10, *A* and *B*) or on CT images if available.
2. A 2.0-mm diameter and 9-mm long LOMAS miniscrew is used for a thinner infrazygomatic crest and a low

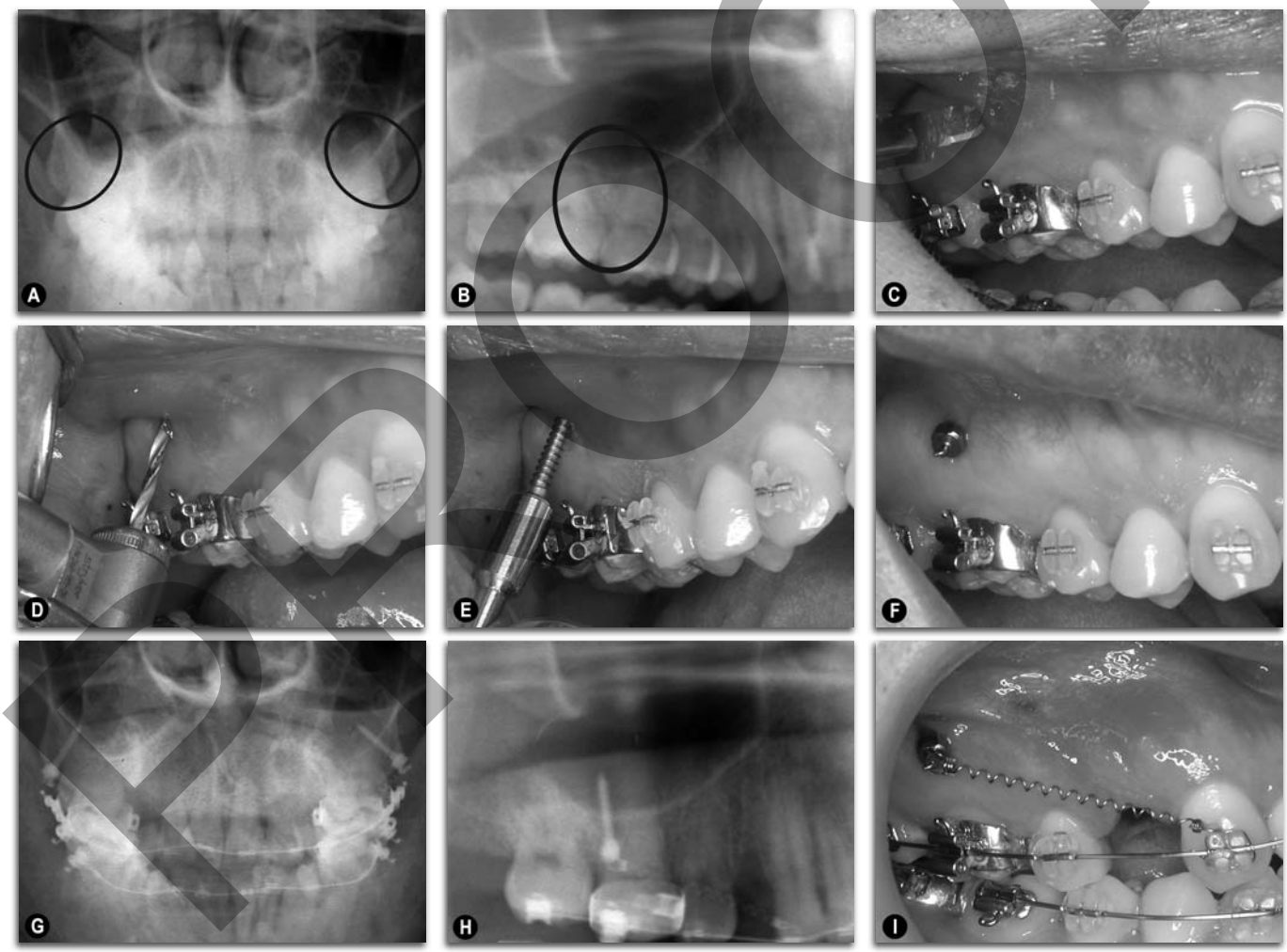

Fig. 15-10

LOMAS placement in infrazygomatic crest. **A,** Pretreatment posteroanterior cephalometric radiograph to evaluate infrazygomatic crest thickness and floor of the maxillary sinus. **B,** Pretreatment panoramic radiograph to evaluate infrazygomatic crest thickness and floor of the maxillary sinus. **C,** Vertical incision with a No. 15 surgical blade at the mucogingival junction above the maxillary first molar. **D,** Pilot hole prepared at 60 to 75 degrees and 13 to 15 mm above occlusal plane. **E,** LOMAS miniscrew is screwed into the infrazygomatic crest. **F,** Final position of LOMAS miniscrew. **G,** Position of miniscrew on posteroanterior cephalometric radiograph. **H,** Position of miniscrew on panoramic radiograph. **I,** Direct loading of miniscrew with NiTi closed coil spring.

maxillary sinus floor. A 2.0-mm diameter and 11-mm long LOMAS miniscrew is used for a thicker infrazygomatic crest and a high maxillary sinus floor.

3. A 2-mm vertical incision is made with a No. 15 surgical blade at the mucogingival junction above the maxillary first molar (Fig. 15-10, *C*). A periosteal elevator is used to raise a mucogingival flap and expose the cortical bone.
4. The bone density is established using the No. 15 surgical blade as previously described.
5. When the bone density is D2, a 1.5-mm pilot hole is prepared at 60 to 75 degrees and 13 to 15 mm above the occlusal plane (Fig. 15-10, *D*).[22] The selected LOMAS miniscrew is screwed into the infrazygomatic crest with the LOMAS screwdriver (Fig. 15-10, *E* and *F*).
6. When the bone density is D3, the selected LOMAS miniscrew is screwed directly into the infrazygomatic crest without a pilot hole.
7. The site and LOMAS miniscrew are irrigated thoroughly with saline.
8. Postoperative radiographs are taken (Fig. 15-10, *G* and *H*).
9. The LOMAS miniscrew is loaded immediately (Fig. 15-10, *I*).

Mandibular External Oblique Ridge

The external oblique ridge is a pillar of cortical bone running from the ascending ramus down to the lateral extent of the mandibular body at the molar region (Figs. 15-3 and 15-7, *A*). The anteroinferior extent of the external oblique ridge is usually lateral to and distal to the first molar (Fig. 15-11). Therefore, when LOMAS miniscrew is placed in the external oblique ridge, it is always placed between the first and second molars. Guidelines are as follows:

1. The anteroinferior extent of the external oblique ridge is determined on the panoramic and posteroanterior cephalometric radiographs (Fig. 15-12, *A* and *B*) or on the CT images when they are available.
2. A 2-mm vertical incision is made with a No. 15 surgical blade at the mucogingival junction between the first and second molars. A periosteal elevator is used to raise a mucogingival flap and expose the cortical bone (Fig. 15-12, *C*).
3. A 1.5-mm pilot hole is prepared at 30 to 40 degrees to the facial surface of the first molar, which is also at a right angle relative to the surface of the external oblique ridge (Fig. 15-12, *D*).
4. A 2.0-mm diameter and 7- or 9-mm long LOMAS miniscrew is selected.
5. The selected LOMAS miniscrew is screwed into the external oblique ridge with the LOMAS screwdriver (Fig. 15-12, *E* and *F*).
6. The site and LOMAS miniscrew are irrigated thoroughly with saline.
7. Postoperative radiographs are taken (Fig. 15-12, *G* and *H*).
8. The LOMAS miniscrew is loaded immediately (Fig. 15-12, *I*).

ORTHODONTIC MECHANICS

LOMAS mechanics are designed around the concept of *one LOMAS miniscrew at one site for multiple purposes,* such as retraction or protraction, intrusion or extrusion of anterior and/or posterior teeth, in either extraction or nonextraction cases.[15] The combination of LOMAS miniscrews and the following auxiliary appliances provide the ability to treat various malocclusions:

1. Crimpable hooks or power arms (Fig. 15-13) can be attached on the arch wire distal to the canines for en masse retraction or at any other site for different purposes.
2. Nickel titanium closed coil springs (NiTi CCSs; Fig. 15-13) are attached from the LOMAS miniscrews to the crimpable hooks for en masse retraction, or from the LOMAS miniscrews to the hooks on the second molars for the protraction, or directly to the arch wire for intrusion of anterior or posterior teeth.
3. CNA transpalatal arch (32CNA-TPA) and CNA lingual holding arch (32CNA-LHA) are made of 0.032-inch beta NiTi wire (CNA, Ortho Organizer, Carlsbad, California) and are built with mesial angulation and buccal root torque. They are inserted into weldable/bondable lingual sheaths for active control of intermolar width, molar rotation, and torque during retraction or protraction.
4. CNA lever arms are made of 0.017 × 0.025-inch beta-NiTi wire (CNA). They are used to intrude or extrude anterior teeth (Fig. 15-14)

Although the LOMAS miniscrews can be used for individual tooth intrusion or extrusion, retraction or protraction, or correction of a posterior crossbite, the following LOMAS mechanics pertain primarily to complete extraction and nonextraction treatment.

Fig. 15-11

The external oblique ridge runs from the ascending ramus down to the mandibular body, where it ends distolateral to the mandibular first molar.

LOMAS Extraction Mechanics

LOMAS extraction mechanics are as follows:

1-1. En masse retraction of anterior teeth (Fig. 15-13)

These mechanics are indicated for correction of Class I bimaxillary dentoalveolar protrusion, Class II, division 1 maxillary dentoalveolar protrusion, or Class III mandibular dentoalveolar protrusion cases that do not require anterior intrusion. The LOMAS miniscrews can be placed in the maxillary and/or mandibular interdental bone between the first molars and second premolars or in the infrazygomatic crest and/or the external oblique ridge. The main arch wire should be 0.016 × 0.022-inch or thicker stainless steel with anterior lingual root torque to prevent lingual tipping of the anterior teeth and distal tipping of the posterior teeth during retraction. Crimpable hooks are attached on the arch wire distal to the canines. Bilateral medium-force NiTi CCSs are attached diagonally from the LOMAS miniscrews to the crimpable hooks for en masse retraction. A 32CNA-TPA or 32CNA-LHA with mesial angulation and lingual crown torque is inserted into the lingual sheaths on the molars for control of intermolar width, molar rotation, and torque during en masse retraction.

1-2. En masse retraction and intrusion of anterior teeth (Fig. 15-14)

These mechanics are almost identical to the preceding mechanics (1-1), except that CNA lever arms are added for intrusion. The mechanics are indicated for

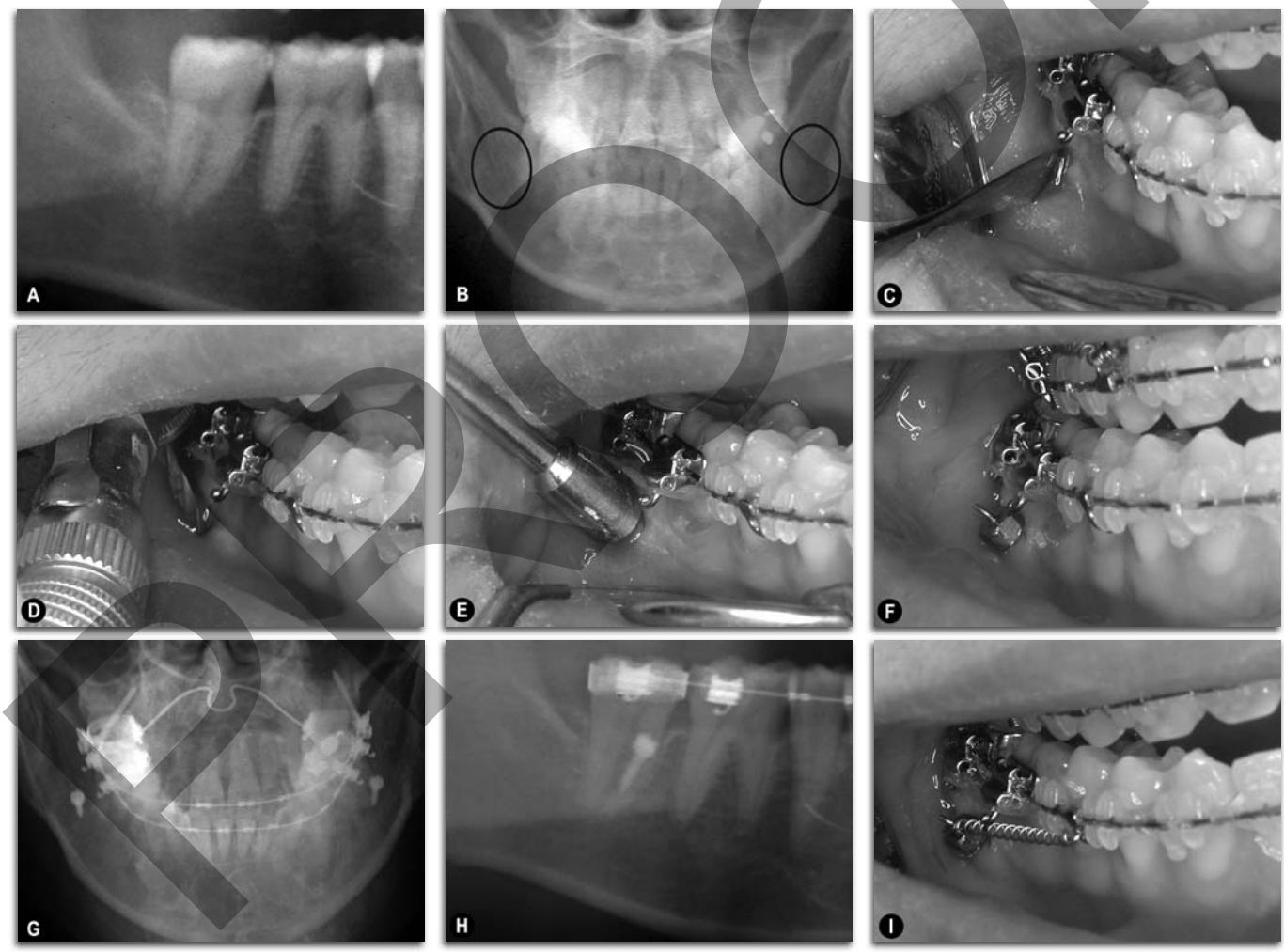

Fig. 15-12

LOMAS placement in external oblique ridge. **A,** Pretreatment panoramic radiograph to evaluate external oblique ridge. **B,** Pretreatment posteroanterior cephalometric radiograph to evaluate external oblique ridge. **C,** After the vertical incision, a periosteal elevator is used to reflect the soft tissue at the mucogingival junction between the first and second molars. **D,** Pilot hole prepared at 30 to 40 degrees to the facial surface of the first molar. **E,** LOMAS miniscrew is screwed into the external oblique ridge. **F,** Final position of LOMAS miniscrew. **G,** Position of miniscrew on posteroanterior cephalometric radiograph. **H,** Position of miniscrew on panoramic radiograph. **I,** Direct loading of miniscrew with NiTi closed coil spring.

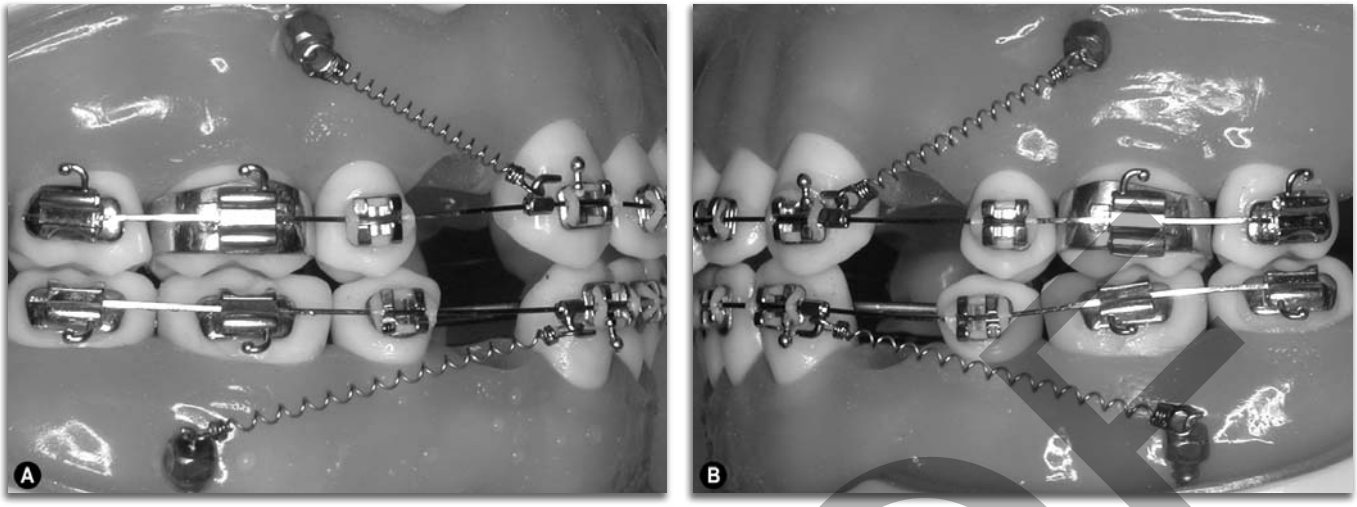

Fig. 15-13

Extraction mechanics 1-1 for en masse retraction of anterior teeth. **A,** Right buccal photograph. **B,** Left buccal photograph.

correction of Class I bimaxillary dentoalveolar protrusion, Class II, division 1 maxillary dentoalveolar protrusion, or Class III mandibular dentoalveolar protrusion cases that require anterior retraction and intrusion. The CNA lever arms are inserted into the auxiliary tubes on the molars and are hooked over the arch wire between the canines and lateral incisors for en masse intrusion of the anterior teeth. Alternatively, the CNA lever arms can be inserted into the auxiliary rectangular tube of the LOMAS Quattro screws, if used.

2-1. En masse retraction of anterior teeth and posterior tooth intrusion (Fig. 15-15)

These mechanics are indicated for correction of high-angle Class I bimaxillary dentoalveolar protrusion or Class II, division 1 maxillary dentoalveolar protrusion with anterior open bite that requires anterior retraction and posterior intrusion for mandibular counterclockwise rotation. For maximal counterclockwise rotation, both the maxillary and mandibular posterior teeth should be intruded. When the appropriate amount of overbite has been obtained or the gummy smile has been eliminated, the mechanics are switched to extraction mechanics 2-2 (Fig. 15-16). The LOMAS miniscrews can be placed in the maxillary and/or mandibular interdental bone between the first molars and second premolars, or in the infrazygomatic crest and/or the external oblique ridge. The main arch wire should be 0.016 × 0.022-inch or thicker stainless steel with anterior lingual root torque to prevent lingual tipping of the anterior teeth. Crimpable hooks are attached on the arch wire distal to the canines. Bilateral medium-

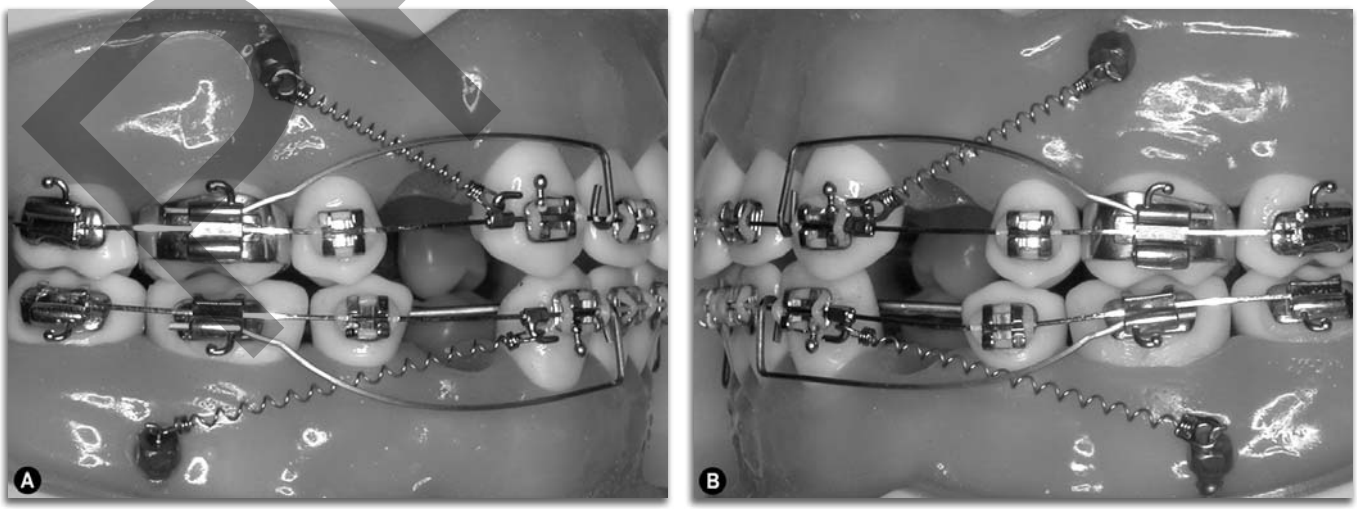

Fig. 15-14

Extraction mechanics 1-2 for en masse retraction and intrusion of anterior teeth. **A,** Right buccal photograph. **B,** Left buccal photograph.

force NiTi CCSs are attached diagonally from the LOMAS miniscrews to the crimpable hooks for en masse retraction. Bilateral medium-force NiTi CCSs are also attached vertically to the arch wire for posterior intrusion. A 32CNA-TPA or 32CNA-LHA with mesial angulation and lingual crown torque is inserted into the lingual sheaths on the molars.

2-2. En masse retraction and intrusion of anterior teeth and posterior tooth intrusion (Fig. 15-17)

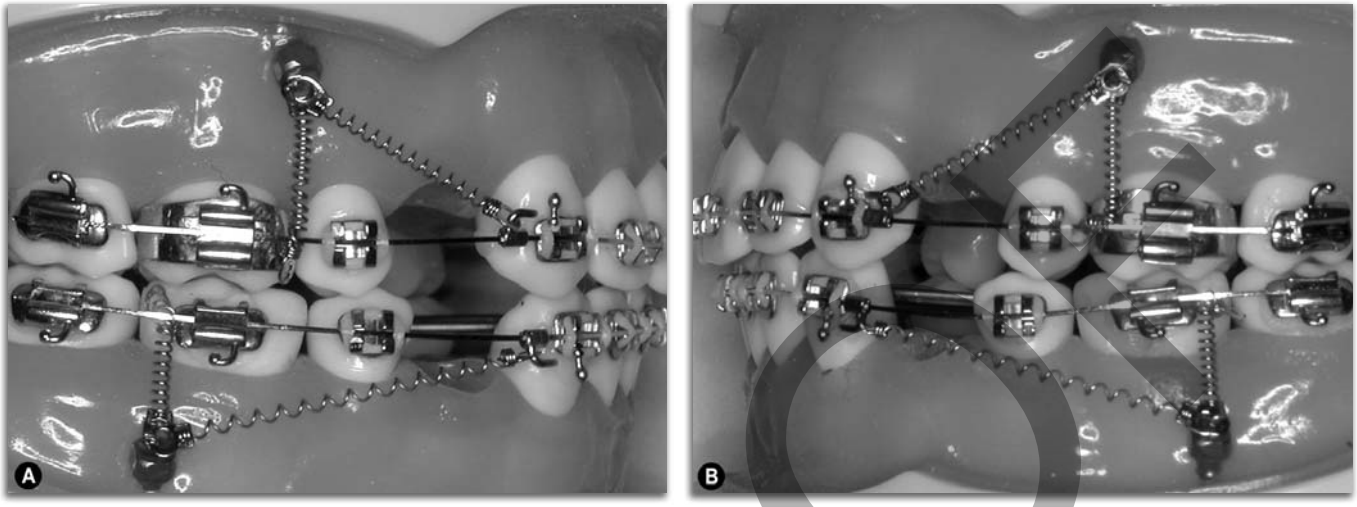

Fig. 15-15

Extraction mechanics 2-1 for en masse retraction of anterior teeth and posterior tooth intrusion. **A,** Right buccal photograph. **B,** Left buccal photograph.

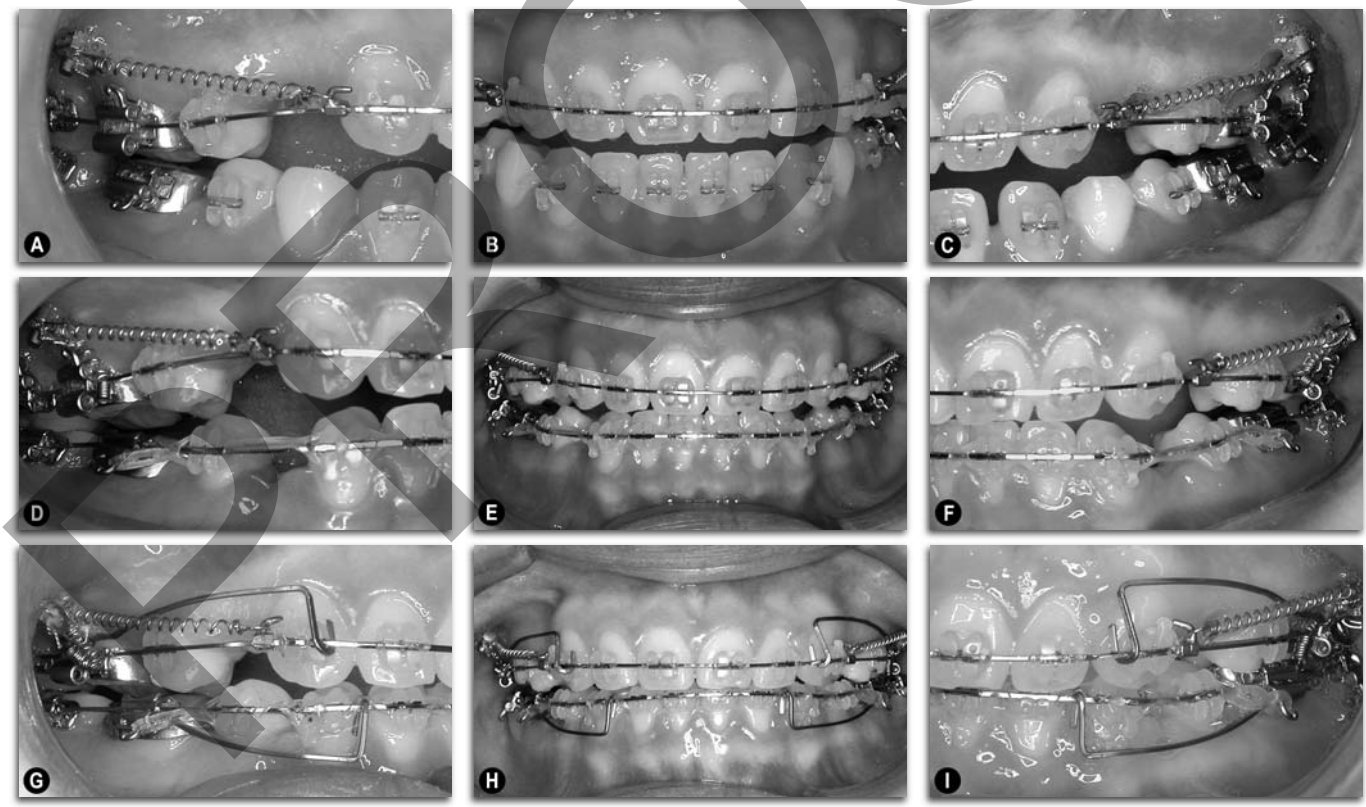

Fig. 15-16

Transition of different extraction mechanics during open bite treatment. **A,** Right buccal photograph of extraction mechanics 1-1. **B,** Anterior photograph of extraction mechanics 1-1. **C,** Left buccal photograph of extraction mechanics 1-1. **D,** Right buccal photograph of extraction mechanics 2-1. **E,** Anterior photograph of extraction mechanics 2-1. **F,** Left buccal photograph of extraction mechanics 2-1. **G,** Right buccal photograph of extraction mechanics 2-2. **H,** Anterior photograph of extraction mechanics 2-2. **I,** Left buccal photograph of extraction mechanics 2-2.

These mechanics are almost identical to the preceding mechanics (2-1), except that CNA lever arms are added for intrusion. These mechanics are indicated for correction of high-angle Class I bimaxillary dentoalveolar protrusion or Class II, division 1 maxillary dentoalveolar protrusion with a gummy smile and anterior open bite that requires anterior retraction and intrusion and posterior intrusion for mandibular counterclockwise rotation. For maximal counterclockwise rotation, both the maxillary and mandibular posterior teeth should be intruded.

3-1. En masse retraction of anterior teeth and intrusion with posterior tooth distalization (Fig. 15-18)

These mechanics are indicated for anterior retraction of more than 7 mm and posterior distalization and intrusion for counterclockwise mandibular rotation, such as in high-angle Class I bimaxillary dentoalveolar protrusion or Class II, division 1 maxillary dentoalveolar protrusion with anterior open bite. The treatment results of these mechanics are similar to those with orthognathic surgery.[23] For maximal counterclockwise rotation, both the maxillary and mandibular posterior teeth should be intruded. When the appropriate amount of overbite has been obtained or the gummy smile has been eliminated, the mechanics are switched to extraction mechanics 3-2 (Fig. 15-19). The LOMAS miniscrews should be placed only in the infrazygomatic crest or the external oblique ridge. The interdental sites

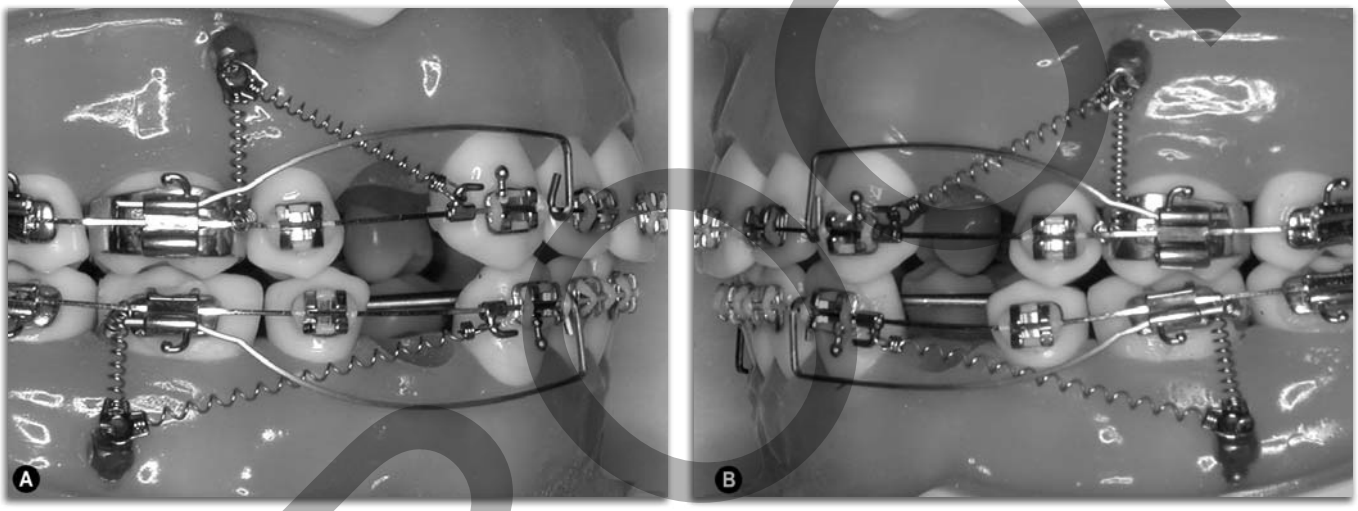

Fig. 15-17

Extraction mechanics 2-2 for en masse retraction and intrusion of anterior teeth and posterior tooth intrusion. **A,** Right buccal photograph. **B,** Left buccal photograph.

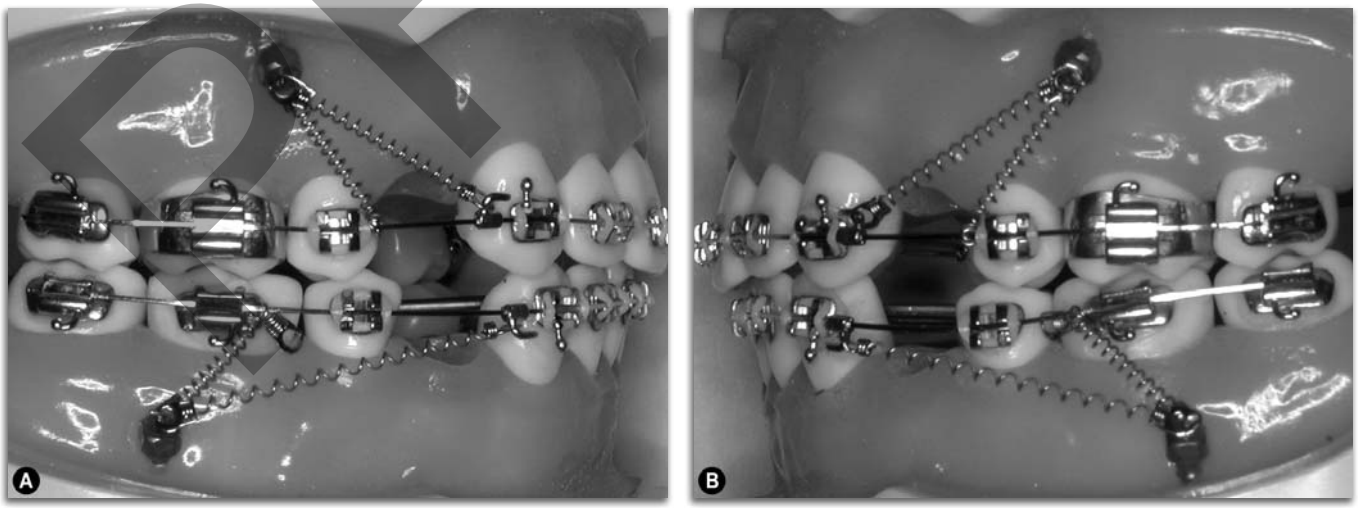

Fig. 15-18

Extraction mechanics 3-1 for en masse retraction of anterior teeth and intrusion with posterior tooth distalization. **A,** Right buccal photograph. **B,** Left buccal photograph.

are contraindicated. The main arch wire should be 0.016 × 0.022-inch or thicker stainless steel with anterior lingual root torque to prevent lingual tipping of the anterior teeth. Crimpable hooks are attached on the arch wire distal to the canines. Bilateral medium-force NiTi CCSs are attached diagonally from the LOMAS miniscrews to the crimpable hooks for en masse retraction. Bilateral medium-force NiTi CCSs are also attached diagonally to the arch wire just mesial to the second premolar brackets for posterior distalization and intrusion. A 32CNA-TPA or 32CNA-LHA with mesial angulation and lingual crown torque is inserted into the lingual sheaths on the molars.

3-2. En masse retraction and intrusion of anterior teeth and intrusion with posterior tooth distalization (Fig. 15-19)

These mechanics are almost identical to the preceding mechanics (3-1), except that CNA lever arms are added for intrusion. These mechanics are indicated for anterior intrusion and retraction of more than 7 mm and posterior distalization and intrusion for counterclockwise mandibular rotation, such as in high-angle Class I bimaxillary dentoalveolar protrusion or Class II, division 1 maxillary dentoalveolar protrusion with a gummy smile. The treatment results of these mechanics are similar to those with orthognathic surgery.[23] For maximal counterclockwise rotation, both the maxillary and mandibular posterior teeth should be intruded.

4. En masse protraction of the maxillary posterior teeth, extrusion of maxillary anterior teeth, and en masse retraction of mandibular anterior teeth (Fig. 15-20)

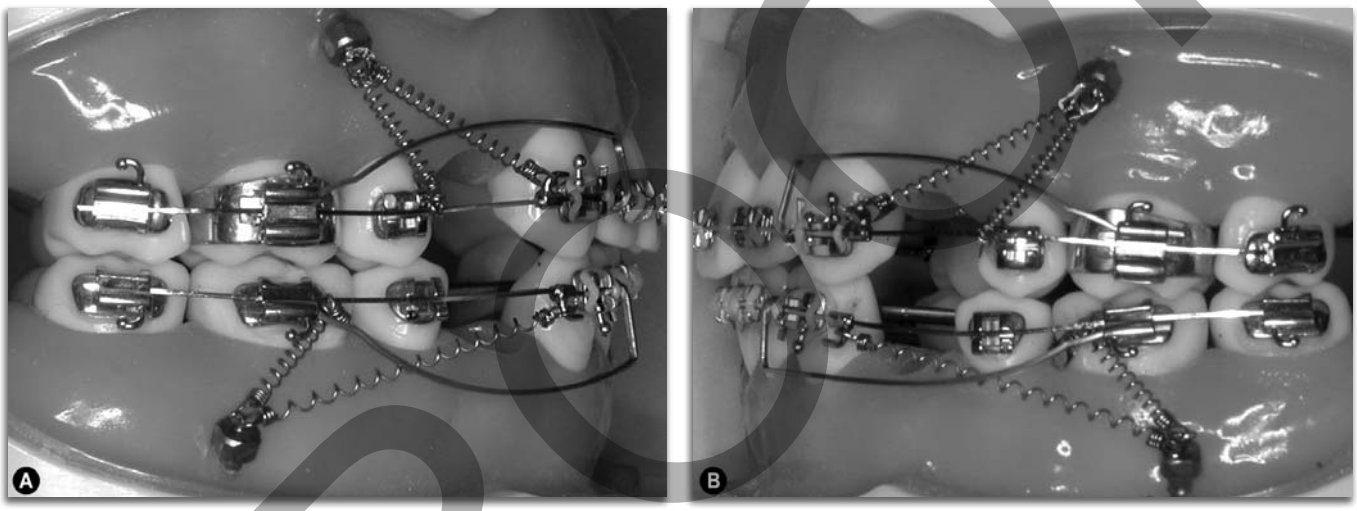

Fig. 15-19

Extraction mechanics 3-2 for en masse retraction and intrusion of anterior teeth and intrusion with posterior tooth distalization. **A,** Right buccal photograph. **B,** Left buccal photograph.

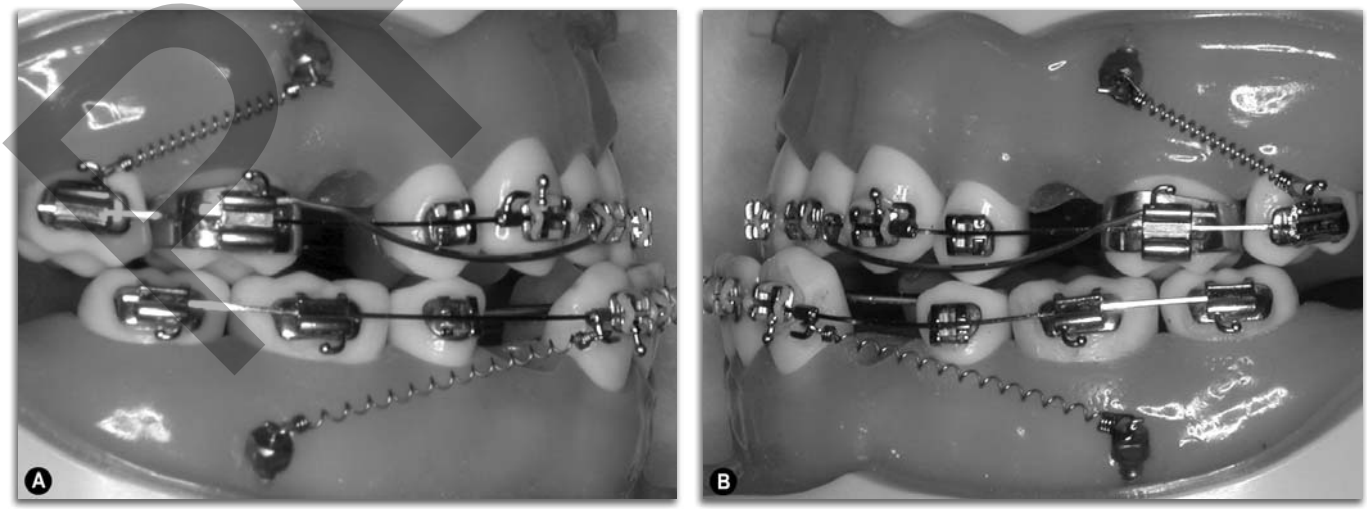

Fig. 15-20

Extraction mechanics 4 for en masse protraction of the maxillary posterior teeth, extrusion of maxillary anterior teeth, and en masse retraction of mandibular anterior teeth. **A,** Right buccal photograph. **B,** Left buccal photograph.

These mechanics are indicated for correction of a mild skeletal Class III with an anterior crossbite. The maxillary second and mandibular first premolars are extracted and the maxillary dentition is extruded, resulting in downward tilting of the maxillary occlusal plane and clockwise mandibular rotation. The LOMAS miniscrews should be placed only in the infrazygomatic crest or external oblique ridge. The maxillary arch wire should be 0.016 × 0.022-inch or thicker stainless steel with anterior facial root torque to prevent facial tipping of the anterior teeth. The mandibular arch wire should be 0.016 × 0.022-inch or thicker stainless steel with anterior lingual root torque.

Bilateral heavy-force NiTi CCSs are attached from the LOMAS miniscrews to the hooks of the maxillary second molars for en masse protraction. Bilateral heavy-force NiTi CCSs are also attached diagonally to the arch wire distal to the canines for en masse anterior retraction. A 32CNA-TPA with mesial angulation and lingual crown torque is inserted into the lingual sheaths on the molars. Extrusion CNA lever arms are inserted into the auxiliary rectangular tube in the LOMAS Quattro miniscrews and are hooked over the arch wire between the maxillary canines and lateral incisors for anterior extrusion.

LOMAS Nonextraction Mechanics

LOMAS nonextraction mechanics are as follows:

1-1. En masse distalization of the entire dentition (Fig. 15-21)

These mechanics are indicated for correction of Class I or Class II cases with anterior crowding and/or mild dentoalveolar protrusion where premolar extraction is undesirable. The LOMAS miniscrews should be placed in the infrazygomatic crest and/or the external oblique ridge. The third molars should be extracted if present. The main arch wire should be 0.016 × 0.022-inch or thicker stainless steel with anterior lingual root torque to prevent lingual tipping of the anterior teeth and distal tipping of the posterior teeth during retraction. Crimpable hooks are attached on the arch wire distal to the canines. Bilateral heavy-force NiTi CCSs are attached from the LOMAS miniscrews to the crimpable hooks for en masse retraction. A 32CNA-TPA or 32CNA-LHA with mesial angulation and lingual crown torque is inserted into the lingual sheaths on the molars for control of intermolar width, molar rotation, and torque during en masse retraction.

1-2. En masse distalization of the entire dentition with anterior tooth en masse intrusion and retraction (Fig. 15-22)

These mechanics are almost identical to the preceding mechanics (1-1), except that CNA lever arms are added for intrusion. The mechanics are indicated for correction of Class I or Class II cases with anterior crowding and/or mild dentoalveolar protrusion or Class II, division 2 cases that require anterior and posterior distalization without premolar extraction. The CNA lever arms are inserted into the auxiliary tubes on the molars and are hooked over the arch wire between the canines and lateral incisors for en masse intrusion of the anterior teeth. Alternatively, the CNA lever arms could be inserted into the auxiliary rectangular tube of the LOMAS Quattro screws, if used.

3-1. En masse distalization of the entire dentition with posterior tooth intrusion (Fig. 15-23)

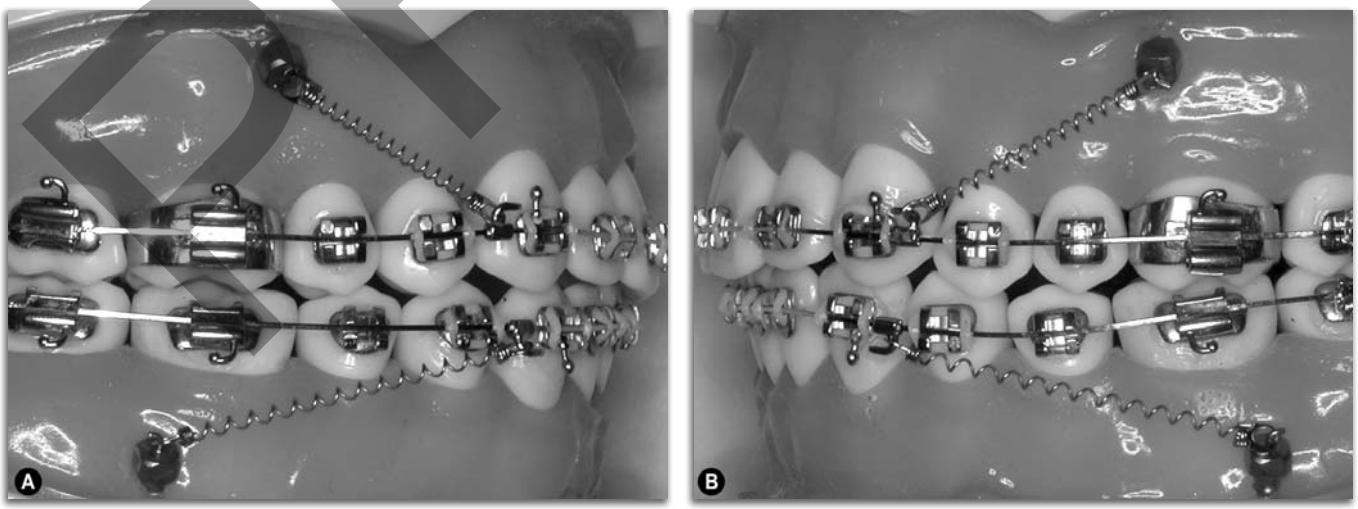

Fig. 15-21

Nonextraction mechanics 1-1 for en masse distalization of the entire dentition. **A,** Right buccal photograph. **B,** Left buccal photograph.

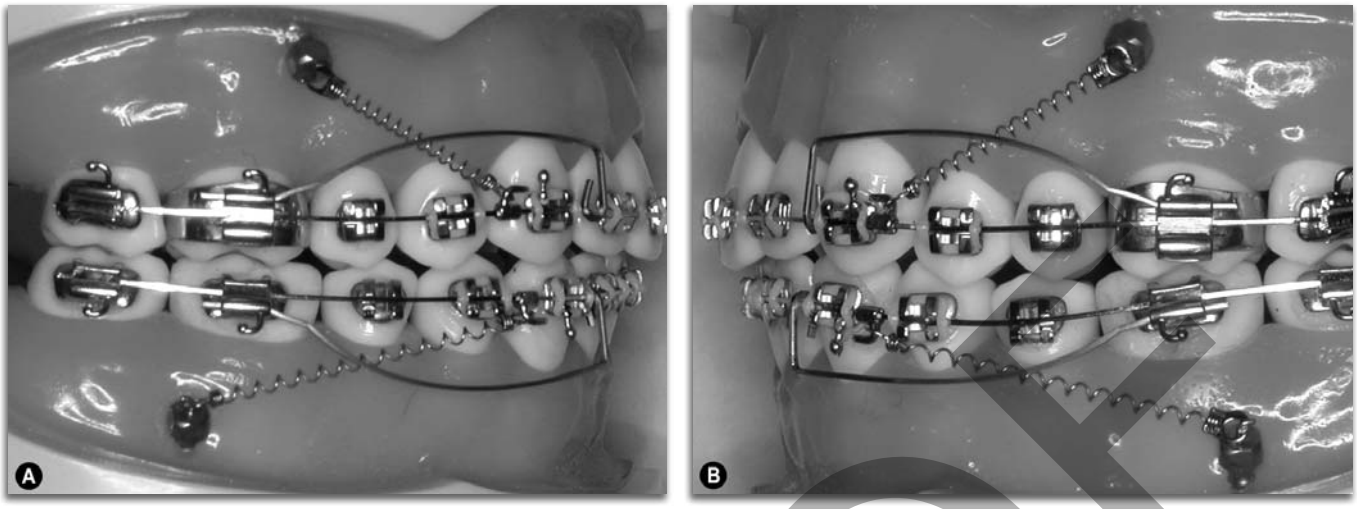

Fig. 15-22

Nonextraction mechanics 1-2 for en masse distalization of the entire dentition with anterior tooth en masse intrusion and retraction. **A,** Right buccal photograph. **B,** Left buccal photograph.

There are no nonextraction mechanics 2-1 because the results are the same as for 3-1. These mechanics are indicated for high-angle Class I or Class II cases with anterior crowding and/or mild dentoalveolar protrusion and anterior open bite in which distalization of the entire dentition with posterior intrusion is required for mandibular counterclockwise rotation.

For maximal counterclockwise rotation, both the maxillary and mandibular posterior teeth should be intruded. When the appropriate amount of overbite has been obtained or the gummy smile has been eliminated, the mechanics are switched to nonextraction mechanics 3-2 (Fig. 15-24). The LOMAS miniscrews should be placed only in the infrazygomatic crest or external oblique ridge. The interdental sites are contraindicated. The third molars should be extracted if present. The main arch wire should be 0.016 × 0.022-inch or thicker stainless steel with anterior lingual root torque to prevent lingual tipping of the anterior teeth. Crimpable hooks are attached on the arch wire distal to the canines. Bilateral heavy-force NiTi CCSs are attached diagonally from the LOMAS miniscrews to the crimpable hooks for en masse distalization. Bilateral medium-force NiTi CCSs are attached diagonally from the LOMAS miniscrews to the arch wire just mesial to the second premolar brackets for posterior distalization and intrusion. A 32CNA-TPA or 32CNA-LHA with mesial angulation and lingual crown torque is inserted into the lingual sheaths on the molars.

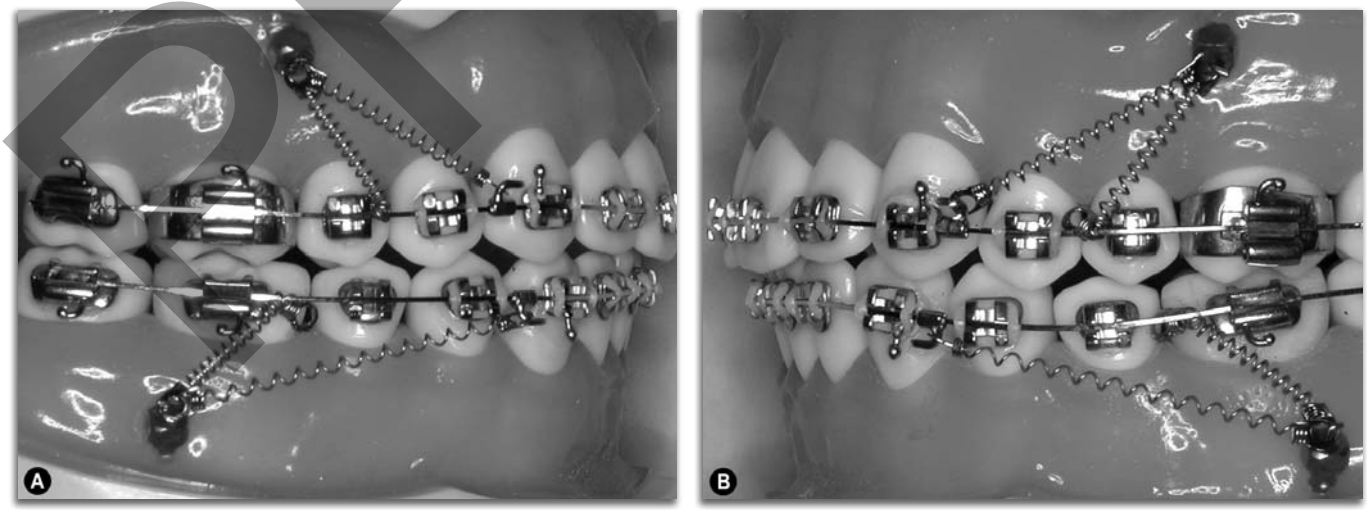

Fig. 15-23

Nonextraction mechanics 3-1 for en masse distalization of the entire dentition with posterior tooth intrusion. **A,** Right buccal photograph. **B,** Left buccal photograph.

3-2. En masse intrusion and distalization of the entire dentition (Fig. 15-25)

These mechanics are almost identical to extraction mechanics (2-1), except that CNA lever arms are added for intrusion. The mechanics are indicated for high-angle Class I or Class II cases with anterior crowding and/or mild dentoalveolar protrusion and a gummy smile in which retraction and intrusion of the entire dentition is required for mandibular counterclockwise rotation. For maximal counterclockwise rotation, both the maxillary and mandibular posterior teeth should be intruded.

4. En masse distalization of the mandibular dentition with en masse protraction and extrusion of the maxillary dentition (Fig. 15-26)

These mechanics are indicated for correction of a mild skeletal Class III with an anterior crossbite. Protraction and extrusion of the maxillary dentition results in downward tilting of the maxillary occlusal plane and clockwise mandibular rotation. The LOMAS miniscrews should be placed in the infrazygomatic crest and the external oblique ridge. The interdental miniscrew sites are contraindicated. The maxillary arch wire should be 0.016 × 0.022-inch or thicker

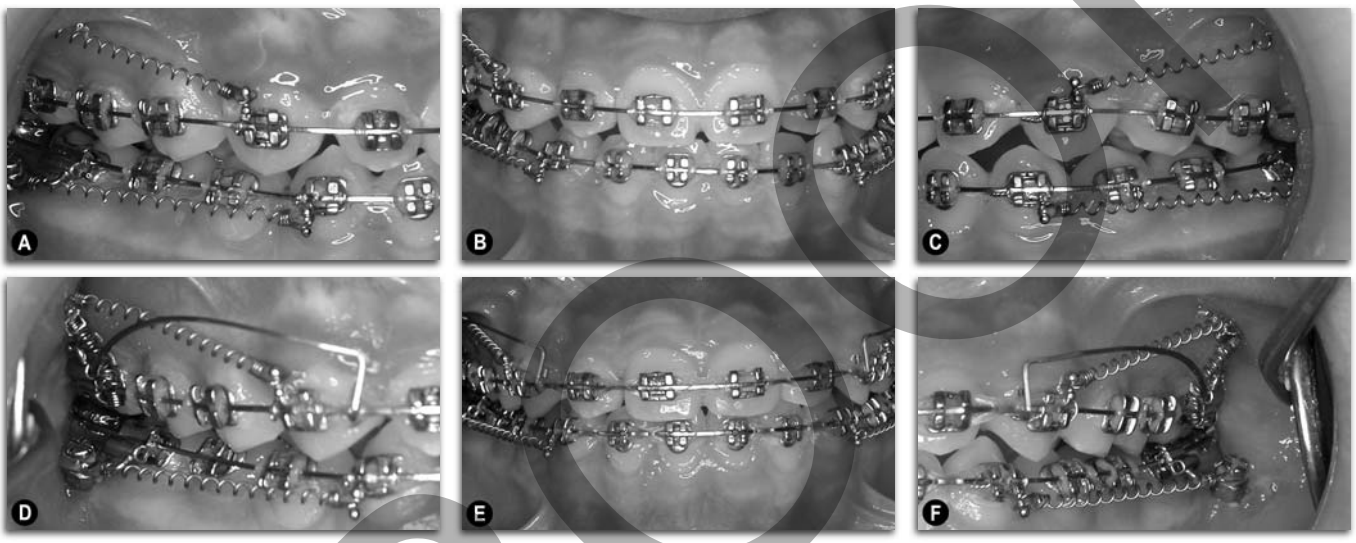

Fig. 15-24

Transition of different nonextraction mechanics during Class I mild bimaxillary protrusion treatment. **A,** Right buccal photograph of nonextraction mechanics 1-1. **B,** Anterior photograph of nonextraction mechanics 1-1. **C,** Left buccal photograph of nonextraction mechanics 1-1. **D,** Right buccal photograph of extraction mechanics 3-2. **E,** Anterior photograph of extraction mechanics 3-2. **F,** Left buccal photograph of extraction mechanics 3-2.

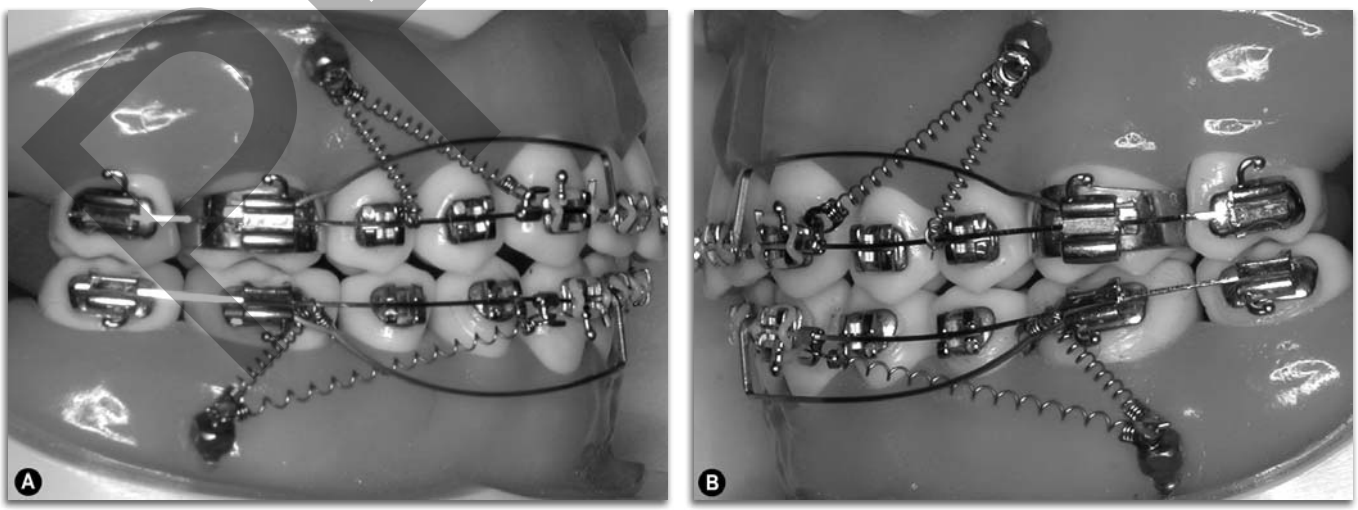

Fig. 15-25.

Nonextraction mechanics 3-2 for en masse intrusion and distalization of the entire dentition. **A,** Right buccal photograph. **B,** Left buccal photograph.

stainless steel with anterior facial root torque to prevent facial tipping of the anterior teeth. The mandibular arch wire should be 0.016 × 0.022-inch or thicker stainless steel with anterior lingual root torque. Bilateral heavy-force NiTi CCSs are attached from the LOMAS miniscrews to the hooks of the maxillary second molars for en masse protraction. Bilateral heavy-force NiTi CCSs are also attached diagonally to the arch wire distal to the mandibular canines for en masse distalization. A 32CNA-TPA with mesial angulation and lingual crown torque is inserted into the lingual sheaths on the molars. Extrusion CNA lever arms are inserted into the auxiliary rectangular tube in the LOMAS Quattro miniscrews and are hooked over the arch wire between the maxillary canines and lateral incisors for anterior extrusion.

REMOVAL PROCEDURE

The LOMAS miniscrews can be removed whenever they are no longer needed or when the orthodontic appliances are removed at the end of the treatment (Fig. 15-27). It may be safest to leave them in place until the end of treatment just in case their use is required at a later point in treatment. No incision or flap is required, and the wound heals within a week. First, a small amount of local infiltration anesthesia is injected around the LOMAS miniscrew. The LOMAS miniscrew is unscrewed with the LOMAS screwdriver. Povidone-iodine (Betadine) is applied around the wound for disinfection, and then 2% chlorhexidine is prescribed for 7 days postoperatively.

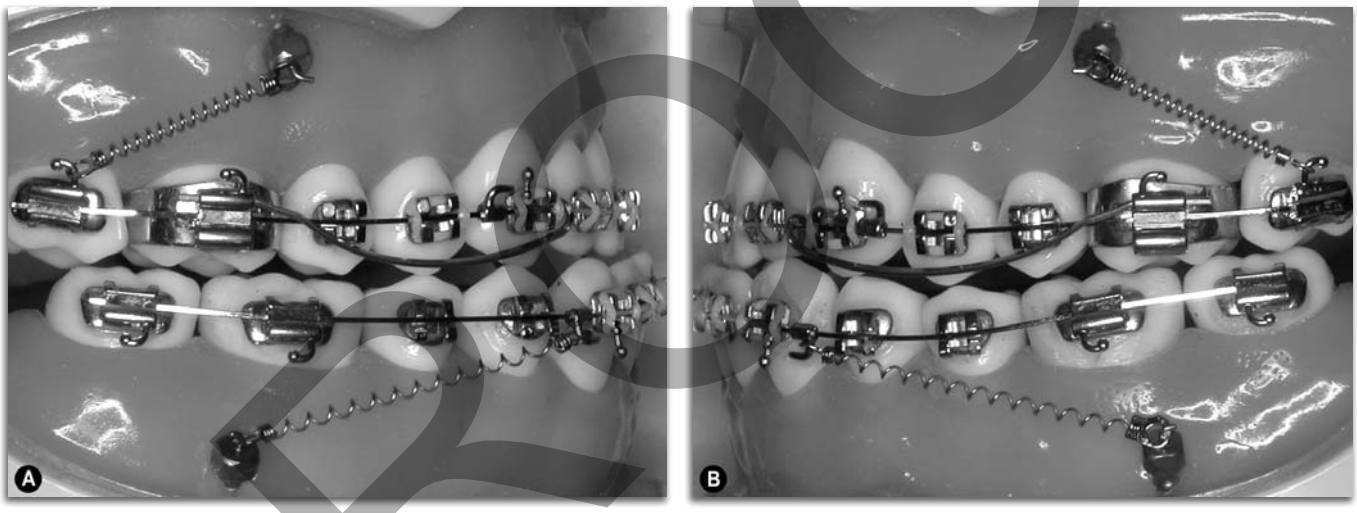

Fig. 15-26.

Nonextraction mechanics 4 for en masse distalization of the mandibular dentition with en masse protraction and extrusion of the maxillary dentition. **A**, Right buccal photograph. **B,** Left buccal photograph.

Fig. 15-27.

LOMAS miniscrew removal procedure. **A,** Seat screwdriver head on LOMAS miniscrew. **B,** Unscrew LOMAS miniscrew. **C,** Wound usually heals within a week

POTENTIAL COMPLICATIONS

A clinical review of our 59 patients reveals that the 120-week success rate of LOMAS miniscrews was 91.1%; failure was therefore 8.9%.[4] Miniscrew loosening occurred mostly in the earlier cases and was within the first 20 weeks after miniscrew placement, suggesting that the learning curve of miniscrew placement plays an important role in success and failure.

For a loosened miniscrew, the miniscrew should be removed and the wound allowed to heal for at least a month before the replacement. Seating a loose miniscrew deeper into bone does not overcome its failure and may increase the potential for infection by pushing bacteria into the miniscrew site.

SUMMARY

The Lin/Liou Orthodontic Mini Anchor System is a self-drilling and self-tapping orthodontic miniscrew. By using the bone density–guided insertion technique, the LOMAS miniscrew can be placed in interdental and non–tooth-bearing areas. To avoid tooth root injury, miniscrews can be placed in interdental areas when the teeth will not be moved mesiodistally. In contrast, the infrazygomatic crests and the external oblique ridges are universal miniscrew sites regardless of whether the teeth will be moved mesiodistally. The LOMAS miniscrew is compatible with the traditional edgewise appliance system. The miniscrew is made with a hook, rectangular auxiliary tube, and a bracket so that it is universally adaptable to any type of tooth movement. Although miniscrews broaden the spectrum of orthodontic treatment, they should not be used as a mainstream treatment option, but rather as a treatment adjunct.

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