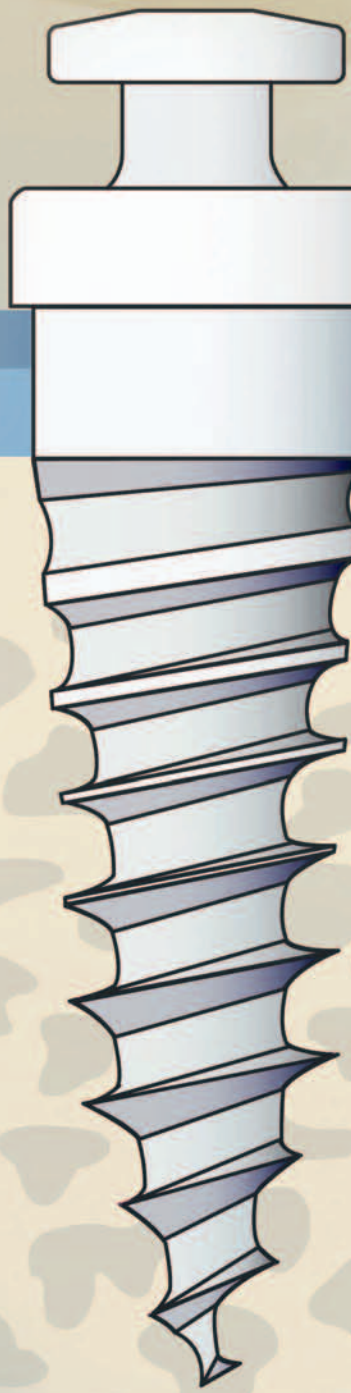
Applications of Orthodontic Mini-Implants

Jong Suk Lee, DDS, MS, PhD
Jung Kook Kim, DDS, MS, PhD
Young-Chel Park, DDS, MS, PhD
Robert L. Vanarsdall, Jr, DDS



quintessence books

TABLE OF CONTENTS

PREFACE

When Dr Edward Angle developed the edgewise bracket for three-dimensional control of teeth, he set the stage for those who followed to design techniques that allowed for more efficient treatment and better outcomes. Their common objective was to minimize unwanted tooth movements and at the same time promote control of practical three-dimensional tooth movements. Development of the simple, stable, and easy-to-use orthodontic mini-implant represents a critical turning point in the search for effortless control of orthodontic anchorage.

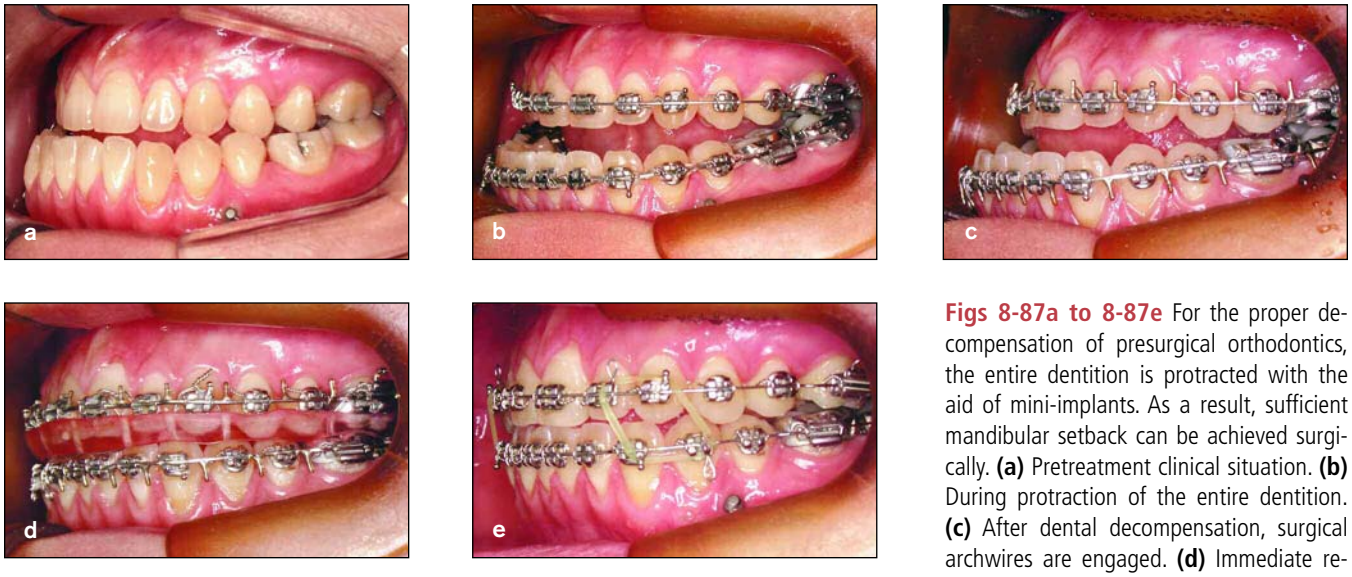
The effectiveness of orthodontic mini-implants does not diminish concerns about loss of anchorage, nor does it solve the problem of loss of anchorage. The orthodontic mini-implant does, however, provide rigid anchorage that makes treatment more efficient, and it also makes biologically permissible movements possible as well. In particular, intrusion of the molars is now practical, in turn allowing vertical disharmony to be corrected with predictability and control.

Of course, many problems remain unresolved. Given the relatively short (10-year) history of the use of mini-implants in orthodontic treatment, long-term data is necessarily limited. More research is needed, particularly with regard to orthopedic applications. Today we find ourselves at the clinical stage of development, which calls for further systematic and prospective research.

This textbook is based on the clinical data we have collected thus far. It describes precise conditions and techniques for clinical application of orthodontic mini-implants and serves as a foundation upon which future treatment using mini-implants can be supported. Despite the need for additional basic and clinical research, we offer this book as an introduction to the new treatment concept of mini-implant orthodontics for those orthodontists and students who have been searching for better treatment results.

This textbook provides an alternative to surgical orthodontics in selected cases. Because the success of this treatment modality depends on new treatment principles and a more precise diagnosis, treatment on the basis of biologic principles is imperative. Can this tiny implant complete the evolutionary advances in mechanotherapy of the past 100 years, transform the treatment paradigm, extend the scope of nonsurgical therapy, and usher in a new era in orthodontic treatment? We believe so, and we think you will too after reading this book.

Figs 8-86a to 8-86c A lever arm bonded to the implant is used to control the line of action. **(a)** Pretreatment clinical situation. **(b)** During protraction. **(c)** Result after protraction; molar relationship is improved. (Courtesy of Dr BS Yoon, Seoul, Korea.)



Figs 8-87a to 8-87e For the proper decompensation of presurgical orthodontics, the entire dentition is protracted with the aid of mini-implants. As a result, sufficient mandibular setback can be achieved surgically. **(a)** Pretreatment clinical situation. **(b)** During protraction of the entire dentition. **(c)** After dental decompensation, surgical archwires are engaged. **(d)** Immediate result after orthognathic surgery. **(e)** During finishing, the surgical splint is removed.

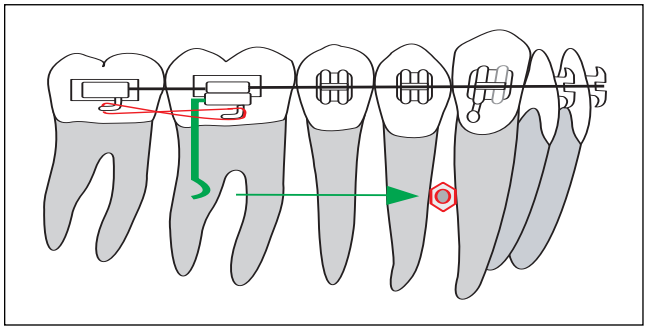


Fig 8-88 For protraction of the entire dentition, the axis of the molar, the vertical dimension, and the arch form must be controlled. To avoid tipping of the teeth and unwanted intrusive force, the lever arm should be adjusted toward the occlusal plane and the protractive force should be placed on the first molars and not the second molars. *(green arrow)* Line of action for protraction.

Special considerations and monitoring

Arch form

In cases of molar protraction, mesial rotation occurs, the arch form is skewed, and the buccal overjet is increased in the second molar area. The arch form may skew readily as distal rotation of the molar occurs.

Occlusal plane canting

Even a very light force may cause adverse side effects if treatment is prolonged. If the treatment period is long, particularly for unilateral protraction of the molar, occlusal plane canting may readily occur even under the influence of slight forces.

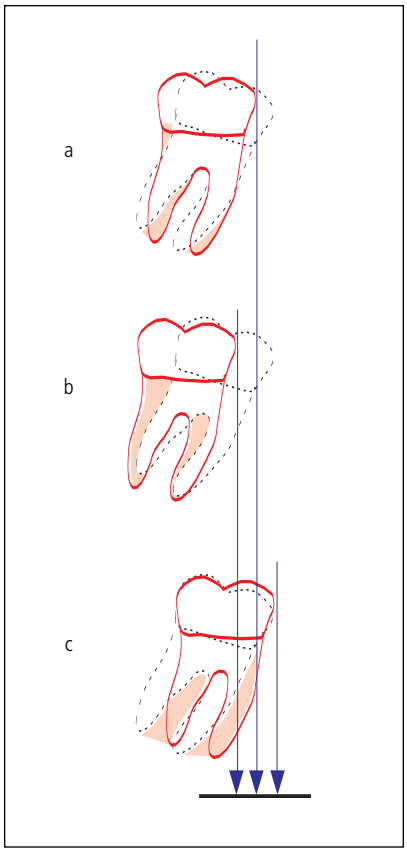


Fig 8-89 The axis control of a single molar can largely be classified into three types: *(a)* axis control by rotation around the center of resistance of a molar; *(b)* axis control by rotation around the distal root apex of a center of resistance of a molar; and *(c)* axis control by root movement. Among these three types, axis control by root movement requires the largest number of alveolar bone reactions and, therefore, requires more anchorage and longer treatment time. (*Shaded area* indicates reaction of alveolar bone required for movement.)

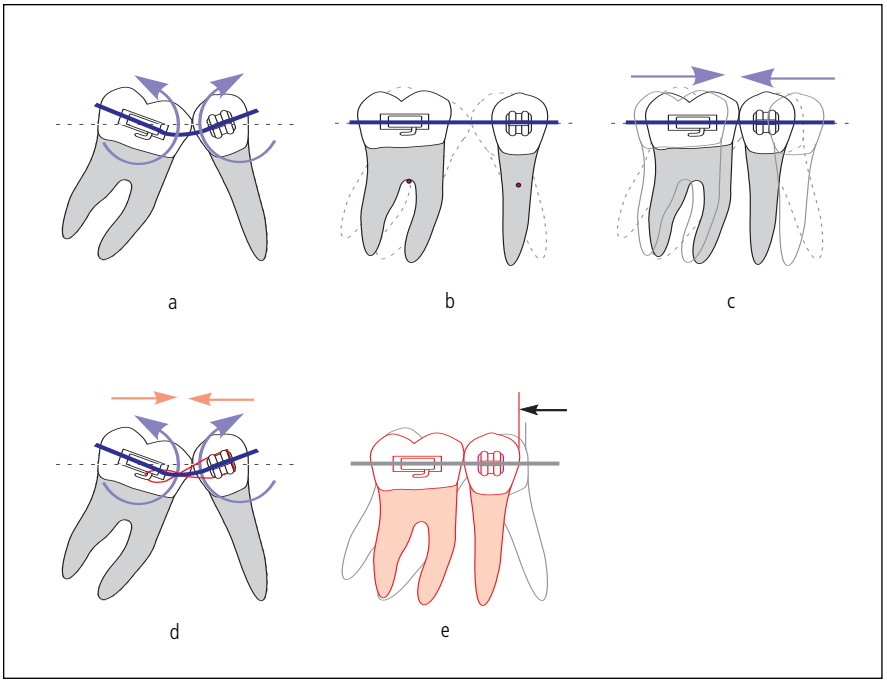


Fig 8-90 Rowboat effect. *(a)* The insertion of a wire into tipped teeth generates moments in the opposite directions; because of these moments, the tooth rotates around the center of resistance. *(b)* Consequently, a space between the teeth is generated. *(c)* If the retractive force is delivered mutually until space closure occurs, anteroposterior movement will take place, depending on the anchorage value (the root surface area). In other words, if the generation of the space *(a)* is prevented by *(d)* rope tie, this is equivalent to the delivery of a retractive force on each other; therefore, it is much like performing *(a)* and *(c)* simultaneously, so that *(e)* uprighting of the tooth and retraction of the premolar occur together. In summary, through the rowboat effect, axis control results in a change of the anteroposterior tooth position.

Periodontal considerations

Because gingival remodeling is much slower than alveolar remodeling, space closure is usually accompanied by problems of soft tissue bunching or excess. Treatment of problems related to gingival excess after space closure and additional surgical excisions might be needed.

Moreover, as gingival tissue is folded, accessibility is decreased and oral hygiene control becomes difficult. Close monitoring should be continuous throughout the treatment, particularly at the mesial side of protracted molars.

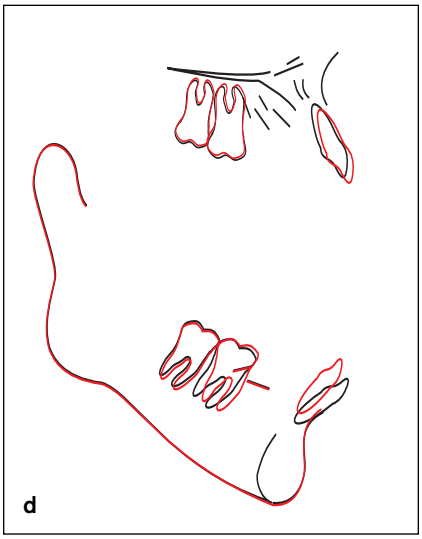
MOLAR AXIS CONTROL

Treatment planning and biomechanics

Broadly speaking, molar axis control can be classified into three types according to the treatment objective (Fig 8-89). The force system for each type, the required period of treatment time, and the degree of difficulty differ accordingly (Fig 8-90).

Fig 9-61a Because the patient did not cooperate in the use of maxillomandibular elastics, the anterior teeth were excessively intruded. As a result, the anterior vertical relationship and the smile line worsened.

Fig 9-61b The anterior vertical relationship was improved by intrusion of the posterior and anterior teeth.



Figs 9-61c and 9-61d Cephalometric superimpositions of tracings of *(black)* Fig 9-61a and *(red)* Fig 9-61b.

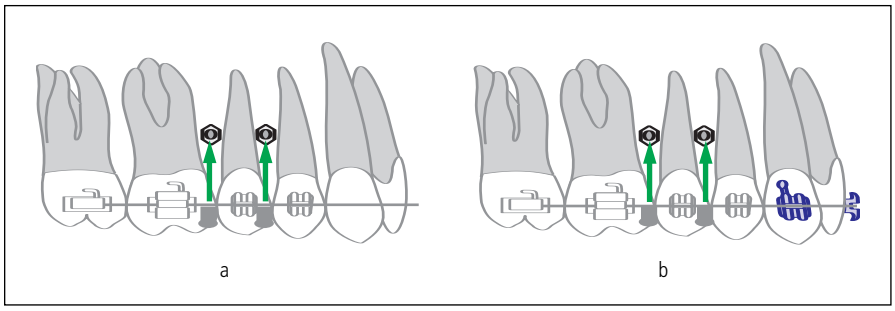
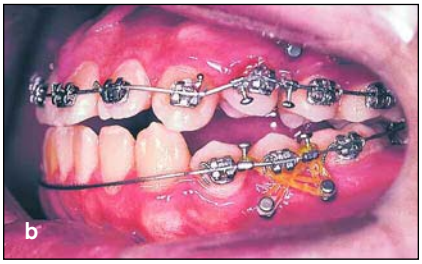


Fig 9-62 *(a)* The best way to prevent anterior teeth from being excessively intruded is to refrain from bonding brackets to anterior teeth until the molars are intruded up to the position of the treatment objective. *(b)* Bond brackets to anterior teeth only when the entire dentition must be intruded.



Figs 9-63a and 9-63b Intrusion occurs more easily in premolar areas than in molar areas because of the difference in the size of the root and the line of action, which is related to the position of the implant. Creation of a second-order bend or step bend may be useful for these situations.

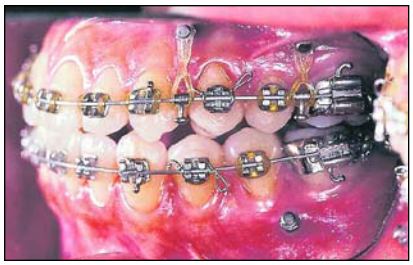


Fig 9-64 When the entire dentition must be intruded, it is most effective to use two implants that are set apart to produce moments that control the inclination of the occlusal plane. However, application of a single force is not enough to control the inclination of the occlusal plane.

Figs 9-65a and 9-65b From the viewpoint of the third-order control, buccal flaring of the teeth should be monitored carefully. Buccal intrusive force tends to intrude the buccal cusp first, so the palatal cusp appears to have fallen. The use of palatal intrusive force is the most effective for intrusive correction. **(a)** Prior to intrusion. **(b)** After intrusion.

Fig 9-66 For disocclusion of posterior teeth, coverage of just one or two teeth may not be sufficient. A vertical stop was formed on the second molar, but it has intruded instead of showing an increased vertical dimension. An anterior bite block should be used to disocclude the posterior teeth.

POSTERIOR EXTRUSION

Posterior extrusion can be classified into two types: posterior extrusion accompanied by an increase in facial vertical dimension, and posterior extrusion with unchanged facial vertical dimension. Extrusion that accompanies stretching of the overall soft tissue may result in relapse, as noted previously.[13]

Treatment planning

For posterior extrusion in conjunction with an increase in facial vertical dimension, disocclusion of the posterior teeth should be performed first. The problem of increasing the vertical dimension in a nongrowing patient is generally not a biomechanical issue but a physiologic one (Fig 9-66). That is, the evaluation of physiologic vertical dimension or freeway space must precede treatment. There is no established protocol for diagnosis and treatment planning to increase the facial vertical dimension,[29,30] and the stability of increased facial vertical dimension is still controversial. Maintenance of an increased facial vertical dimension may be more difficult than the process of increasing the alveolar vertical dimension.

Biomechanics and mechanics

With implants, in contrast to conventional mechanics, extrusion is more difficult than intrusion because of the characteristics of implant mechanics. As in intrusion, in extrusion the molar must be controlled three-dimensionally.

Implants exhibit weak push mechanics (Fig 9-67). In addition, three-dimensional control should be maintained. That is, buccal extrusive force is not enough to accomplish extrusion, and buccal and lingual extrusive forces together are necessary for better torque control (Fig 9-68).