In orthodontics, a theoretical basis commonly is little more than an imaginative, after-the-fact rationalization. A century ago, orthodontists who used jackscrews argued that intermittent forces are "more physiologic." Competing orthodontists who used springs, elastics, grass line, etc. argued that continuous forces are better. Traditionally, the appliance comes first; the biological justification, if any, comes later and only in sufficient doses to "sell" the appliance. In contemporary orthodontics, a classic example would be the claims that a clever piece of plastic or a given bracket–archwire combination can speak the language of the osteoclast and osteoblast and thereby permit treatment effects that the literature argues are impossible. Implants are something of an anomaly: theory preceded and spurred the development of the appliance. The fact that bone cannot grow interstitially, combined with the success of implants in restorative dentistry, implied that implants ought to be able to enhance anchorage. In other words, there was sufficient theoretical basis to warrant investigation. Given that the history of orthodontics is strewn with the wreckage of popular but ultimately flawed "philosophies" and treatments, sound biological theory is not the enemy, but rather a veritable sixth sense, designed to protect both patient and provider. With respect to temporary anchorage devices, theory implies not only that they are worth investigating, but also that, if successful, they will revolutionize patient care and return "diagnosis and treatment planning" to its rightful position in clinical practice. Therein lies the rub. An ability to put teeth where they need to be put, rather than where the appliance du jour tends to leave them, imposes a considerable obligation on the clinician. For a given patient, where should the teeth be placed? This question is the essence of "evidence-based treatment." The fabrication of an answer will be intellectually stimulating and, it is hoped, clinically significant. The process may well presage an orthodontic "golden age" that has nothing to do with money.

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# Contents

1 Introduction ................................................................................. 1  
   Björn Ludwig, Thomas Lietz, S. Jay Bowman, Sebastian Baumgaertel
   1.1 References ........................................................................ 4

2 The Problem of Anchorage ..................................................... 5  
   Peter Schopf, Björn Ludwig, S. Jay Bowman
   2.1 Tooth Movement and Anchorage ...................................... 5
   2.2 Types of Anchorage ....................................................... 6
   2.3 References ..................................................................... 10

3 Mini-screws – Aspects of Assessment and Selection Among Different Systems .................. 11  
   Thomas Lietz. Edited by Sebastian Baumgaertel and S. Jay Bowman
   3.1 Introduction .................................................................. 11
   3.2 General Aspects of Mini-screws ..................................... 12
   3.3 Screw Design ............................................................... 14
      3.3.1 The Screw Program ............................................... 14
      3.3.1.1 Materials .......................................................... 15
      3.3.1.2 Size and Number of Mini-screws ...................... 19
      3.3.2 The Screw Head ....................................................... 23
      3.3.3 The Transgingival Collar ...................................... 26
      3.3.4 Shank and Thread .................................................... 30
   3.4 Accessories in the Delivery Program .............................. 35
      3.4.1 Aids to Find and Mark the Insertion Position ............ 35
      3.4.2 Instruments for Soft Tissue Perforation ..................... 37
      3.4.3 Pilot Drill ............................................................... 37
      3.4.4 Instruments for Insertion ........................................ 39
3.5 Aspects Dependent on the System of Application of Mini-screws ........................................... 44
3.5.1 Delivery of the Screw ................................................................. 44
3.5.2 Insertion of the Screw ............................................................... 47
3.5.3 Interconnection with Orthodontic Devices ........................................ 49
3.5.4 Screw Removal ................................................................. 52
3.5.5 Rate of Success for Screws ....................................................... 52
3.5.6 Publications on the Description of Screws and Systems ....................... 53
3.6 Information from Manufacturers .................................................. 54
3.7 Summary ...................................................................................... 55
3.8 References .................................................................................... 58
3.9 Appendices .................................................................................... 64

4 Insertion of Mini-screws ................................................................. 73
Björn Ludwig, Bettina Glasl, Constantin Landes, Thomas Lietz, S. Jay Bowman

4.1 Preparation for Insertion of Mini-screws ........................................... 73
4.1.1 Pre-surgical Planning ................................................................. 73
4.1.2 Model Analysis and Clinical Treatment Planning .............................. 75
4.1.3 X-ray Analysis ................................................................. 76
4.2 Procedure of Insertion of the Mini-screw/Pin ....................................... 78
4.2.1 Self-cutting or Self-drilling? ....................................................... 78
4.2.2 Choice of an Appropriate Mini-screw ........................................... 79
4.2.3 Instruments and Insertion Preparation .......................................... 80
4.2.4 Insertion of the Mini-screws/Pins Step-by-Step .................................. 82
4.2.4.1 Anesthesia ........................................................................... 82
4.2.4.2 Measurement of the Gingival Thickness .................................. 83
4.2.4.3 Tissue Punch ....................................................................... 83
4.2.4.4 Bone Indentation and Pilot Drill ........................................... 84
4.2.4.5 Manual Insertion of Mini-screws/Pins ................................... 85
4.2.4.6 Inserting Mini-screws with a Dental Handpiece ......................... 87

4.3 Post-operative Phase .................................................................. 87
4.3.1 Healing Phase ........................................................................... 87
4.3.2 Explantation of Mini-screws ......................................................... 88
4.4 References .................................................................................... 89
5 Fields of Application of Mini-Implants ........................................ 91
   Benedict Wilmes. Edited by S. Jay Bowman, Sebastian Baumgaertel

5.1 Direct versus Indirect Anchorage ........................................ 91
   5.1.1 Direct anchorage ................................................ 91
   5.1.2 Indirect Anchorage ............................................ 93

5.2 Clinical Solutions for Different Indications .......................... 95
   5.2.1 Anterior Teeth .................................................. 96
   5.2.1.1 Anchorage of Anterior Teeth ............................ 96
   5.2.1.2 Intrusion/Extrusion of Anterior Teeth ................. 97
   5.2.1.3 Retraction of Anterior Teeth ........................... 101
   5.2.2 Canines ....................................................... 102
   5.2.2.1 Canine Retraction .......................................... 102
   5.2.2.2 Integration of Displaced Canines ....................... 104
   5.2.3 Posterior Teeth ............................................... 105
   5.2.3.1 Anchorage of Posterior Teeth ......................... 105
   5.2.3.2 Intrusion of Posterior Teeth ........................... 108
   5.2.3.3 Uprighting of Tipped Molars ......................... 110
   5.2.3.4 Mesialization of Posterior Teeth ..................... 111
   5.2.3.5 Distalization of Posterior Teeth ..................... 113
   5.2.4 Dental Arch Coordination .................................. 119
   5.2.4.1 Palatal Expansion and Rapid Palatal Expansion (RPE) 119
   5.2.4.2 Transverse Dental Movements ......................... 121
   5.2.4.3 Corrections in the Sagittal Plane and Vertical Dimension 121

5.3 Conclusion .................................................................... 122

5.4 References .................................................................... 122

6 Risks and Prevention Strategies .......................................... 123
   Bettina Glasl, Björn Ludwig, Thomas Lietz, S. Jay Bowman, Sebastian Baumgaertel

6.1 Technical and Physical Criteria ...................................... 123

6.2 The Patient .................................................................. 124
   6.2.1 Anamnestic Criteria ........................................... 124
   6.2.2 Morphological Criteria ....................................... 127

6.3 Iatrogenic Risk Potential .................................................. 128
   6.3.1 Pre-surgical Factors ........................................... 128
   6.3.2 Intra-surgical Factors .......................................... 128
   6.3.3 Post-surgical Factors .......................................... 131

6.4 Application-related Factors .............................................. 132

6.5 System-related Factors .................................................. 133

6.6 References .................................................................... 136
# Integration into Clinical Practice

Bernhard Böhm, S. Jay Bowman, Sebastian Baumgaertel

## 7.1 Conditions

## 7.2 Practice Setting for the Insertion of Mini-screws

### 7.2.1 Devices and Instrumental Equipment

### 7.2.2 Hygiene Requirements and Legal Basis

### 7.2.3 Hygiene Conditions with Mini-screws

## 7.3 Documentation of the Procedure

## 7.4 Patient and Mini-screws

## 7.5 Patient Education and Approval

## 7.6 References

## 7.7 Consent Form

# Outlook: The Shape of Things to Come

S. Jay Bowman, Bettina Glasl, Björn Ludwig, Thomas Lietz, Lysle E. Johnston, Jr.

## 8.1 A Spike in the Ice: a Real Paradigm Shift

### 8.1.1 An Orthodontic Tug of War

### 8.1.2 Primer, Preparation, and Performance

### 8.1.3 Doing the Due Diligence

### 8.1.4 Multitudes of Systems: The Paradox of Choice

### 8.1.5 Education and Informed Consent

#### 8.1.5.1 Consulting with the Patient

#### 8.1.5.2 Informed Consent

#### 8.1.5.3 Adolescents: Special Considerations

## 8.2 Innovations on the Horizon – The Future is Now

### 8.2.1 The Changing Face of Orthodontics: Altering the Extraction Decision with Mini-screws

### 8.2.2 Full Face Orthodontics?

### 8.2.3 Maximum Retraction

### 8.2.4 Avoiding Retraction: Maintain Incisor/Lip Position

### 8.2.5 Extractions: Which Teeth?

### 8.2.6 Another Alternative for Borderline Extraction Patients?

### 8.2.7 Conservative Resolution of Crowding: Leeway Space

## 8.3 The Role of Mini-screws in Class IIs

### 8.3.1 Class II: Maxillary en Masse Retraction

### 8.3.2 Class II: Molar Distalization

#### 8.3.2.1 Anchorage Loss

#### 8.3.2.2 Mini-screw-supported Distalization

#### 8.3.2.3 Mini-screw-supported Distal Jet

### 8.3.2.4 A Better Alternative
8.3.3 Intermaxillary Approaches to Class II Corrections ................................................. 167
  8.3.3.1 Mini-screw-supported Intermaxillary Elastics ................................................. 167
  8.3.3.2 Addressing the Mandible for Class II Correction ........................................... 167
  8.3.3.3 Future Investigations ......................................................................................... 169
8.4 The Role of Mini-Screws in Class IIs ........................................................................... 169
  8.4.1 Class III: Maxillary en Masse Protraction .......................................................... 169
  8.4.2 Class III: Mandibular en Masse Retraction ......................................................... 169
  8.4.3 Mini-screw Adjuncts to Surgery ............................................................................. 169
8.5 Transverse Discrepancies ........................................................................................... 169
8.6 Single Tooth Issues ..................................................................................................... 173
  8.6.1 Uprighting Teeth ................................................................................................. 174
  8.6.2 Individual Labial Root Torque .............................................................................. 174
  8.6.3 Individual Temporary Tooth Replacement .......................................................... 176
8.7 Mini-screw Auxiliaries ................................................................................................. 176
  8.7.1 Bite Openers .......................................................................................................... 177
  8.7.2 Bite Closers ............................................................................................................ 178
  8.7.3 Propeller Arms ...................................................................................................... 178
  8.7.4 Pushmi-Pullyu Mechanics .................................................................................... 180
8.8 Final Considerations .................................................................................................... 180
8.9 References .................................................................................................................. 181

9 Index ............................................................................................................................... 185
In this chapter, various possibilities for clinical mini-implant applications are demonstrated. Due to the large variety of insertion sites for mini-implants, there is a bigger spectrum of indications than for the other skeletal anchorage options.

Before the different treatment options with mini-implant anchorage can be discussed, an explanation of how to couple the mini-implant to the orthodontic appliance (direct versus indirect anchorage) is required. As such, the mechanics of mini-implant anchorage should be an integral part of the orthodontic treatment planning process.

5.1 Direct versus Indirect Anchorage

In general, two different types of anchorage must be distinguished: direct and indirect. Determining the type of anchorage that is more favorable depends on the following clinical or radiological factors: local bone quality, available space (in particular for interradicular insertion) and mucosal thickness. Furthermore, the expected load on the mini-implant should be taken into consideration.

5.1.1 Direct anchorage

In a direct anchorage situation, the implant is directly connected to the dental unit(s) to be moved. In this manner, a purely mini-implant supported anchorage is the result. Depending on the treatment objective, forces can be transferred from the implant to the dental unit(s) using the following modules.

Compression Spring (Fig. 5-1)
The use of a compression spring always requires an additional arch wire or wire segment to stabilize the compression spring (open coil spring). The insertion can sometimes be difficult, and regular reactivation or a change to a new, longer spring is often required. This can often be done without removing the entire set-up by crimping a stop or using an arch lock on the arch wire or segment. It is for these reasons that tension mechanics are often preferred.

Tension Spring (Fig. 5-2)
Super-elastic nickel titanium (NiTi) springs (closed coil springs) are biomechanically more favorable than elastic chains due to their consistent and constant force delivery. Depending on the make of the tension spring and head design of the mini-implant, it may be necessary to attach the spring using a stainless steel ligature or Monkey Hook (American Orthodontics, Sheboygan, WI). Some

Fig. 5-1 Direct anchorage with compression spring: a compression spring is applied on a 16 x 22 NiTi segment-ed arch between mini-implant (interradicular between teeth 6 and 5) and tooth 3. This allows for distalization and de-rotation of the latter.
Chapter 5 Fields of Application of Mini-Implants

Sketch 5-58, Case 58  Maxillary molar distalization using the Keles-Slider: two mini-implants are blocked in the direction of force application to avoid anterior tipping.

Sketch 5-59, Case 59  Distalization of the right molar with cortically anchored Nance button and Distal-Jet element (photo by Dr. B. Ludwig, Traben-Trarbach).

Sketch 5-60, Case 60  Maxillary molar distalization using the distal helix: two mid-palatal mini-implants are coupled in the direction of force application using half a molar band and composite to avoid tipping. A transpalatal arch is inserted in the soldered Mialock. Off this TPA, bilateral springs distalize molars that are connected through a Quadhelix.
5.2.4 Dental Arch Coordination

5.2.4.1 Palatal Expansion and Rapid Palatal Expansion (RPE)

Mini-implant anchorage can also be helpful in the coordination of the maxillary and mandibular dental arches. Rapid palatal expansion (RPE) is often indicated with a maxillary transverse constriction of skeletal origin. Sometimes, however, sufficient dental anchorage cannot be established and more tipping than sutural expansion results. A frequent reason for this can be the dental age. If the required deciduous teeth are mobile, during the late phase of the mixed dentition, adequate anchorage for continuous sutural maxillary expansion is not available. This is especially true when concurrent protraction of the maxilla is planned using a facemask, as waiting for complete eruption and root formation of the premolars is not desirable. An alternative mechanism would be to use the first molars in the posterior and two mini-implants for the anterior area as an anchorage for the Hyrax expander (Dusseldorf Hybrid-Hyrax, Sketch 5-61, Case 61).

In the mutilated dentition (e.g. loss of first molars), mini-implants can be used to replace teeth as anchorage units. Since there is limited bony support in the posterior maxilla in these instances, two mini-implants should be inserted in the loading direction, next to each other, and then connected (Sketch 5-62).

Sketch 5-61, Case 61  Rapid palatal expansion using the Dusseldorf Hybrid-Hyrax: both first molars and two anterior mini-implants serve as anchorage.

In the mutilated dentition (e.g. loss of first molars), mini-implants can be used to replace teeth as anchorage units. Since there is limited bony support in the posterior maxilla in these instances, two mini-implants should be inserted in the loading direction, next to each other, and then connected (Sketch 5-62).

Sketch 5-62  Rapid palatal expansion with reduced number of teeth: mini-implants connected with a molar band and composite in the direction of force application substitute as anchorage units for missing teeth.