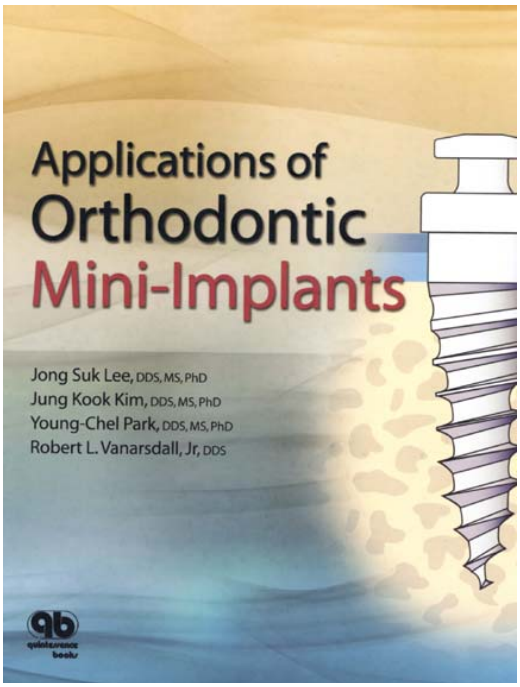
Application of Orthodontic Mini-Implants



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Quintessence Publishing 2007
Price: US$168.00
ISBN: 978-0-86715-465-8

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ACCEPTED FOR PUBLICATION in NOV 2007
By Australian Orthodontic Journal

This book is mandatory reading for all periodontists, surgeons and orthodontists who use or want to use the new technology called orthodontic miniscrew implants, also known as temporary anchorage devices or TADs. This technology is full of promise, but has often delivered disappointment. Many remedies are given in this book, which contains a complete knowledgebase up to 2007 on orthodontic mini-implants. It is a knowledgebase that began about seven years ago. Many of the studies cited are still pending publication in mainstream

journals. Consequently, this book contains much new research and knowledge in the field of mini-implants.

Its Korean authors are all orthodontic university professors, and are the scientists behind many of the studies cited. Their studies have refined the design theory and the protocols for use of TADs. The devices are very specialised and differ from implants designed for dental prosthetics. The initial chapters impart a complete education in the complex concepts involved in mini-implants, including, the principles of metal engineering, the histological and biological responses to the devices and protocols for the use of mini-implants. Previously unpublished anatomical considerations are illustrated using cadaver and 3D dental CT imaging research. Serious consideration of force vector relationships is fundamental to success when planning orthodontic mini-implants, and this topic is extremely well-covered. After reading only a few pages, I realised the folly of using any implants before fully digesting the whole text, and then I realised that these devices have many more applications than I previously thought. The book is very instructive in mechanotherapy generally.

Many problems in clinical orthodontics are now problems 'we used to have' because mini-implants have relegated them to the past. The paradigm shift is huge! Chapter 1 covers the evolution of non-integrating mini-implants for temporary anchorage. This concept is totally different from the osseointegrated implants used for tooth prosthetics. There are 67 references at the end of this chapter. Chapter 2 deals with

the biological principles, including: healing at the implant-tissue interface, differences in bone trauma and healing with pre-drilled and self-drilling implants and factors lessening survival of healthy tissue at the implant interface (127 references). Chapter 3 covers the mechanical design and operator handling of a mini-implant from its tip to its top, and how these factors bear on the success or failure of a mini-implant. For instance, why is there a difference in success between the right and left sides? This chapter has 63 references. Chapter 4 covers treatment planning, and is illustrated with cadaver cross-sections. There are many, clear illustrations showing in great detail: suitable and unsuitable bones for mini-implants, the extent of the attached and free mucosa influencing the choice of site, the thickness of the mucosa and the many other hazards. We are led to conclusions about the proper choice of implant length, thickness, taper, transmucosal height and angulation. All possible sites of placement are very thoroughly discussed (32 references).

Chapter 5 on 'Surgical procedures' explains the keys to obtaining a stable implant: implant handling, importance of proper hand tools, direct and indirect approaches, covered placement, length, diameter, angle, vibration, speed, cooling and loading. Also discussed are: pre-operative planning, appointment scheduling, grip of tools, posture, marking, pre-drilling, direct and indirect approaches, guiding, forces used, post-operative care and patient instruction, removal, loosening, fracture, periodontal injury, damage to teeth and soft tissues,

pain, covering over, infection and choice of an inappropriate site (19 references).

Chapter 6 on 'Mechanics' covers: the three-dimensional movement of the dentition, how to avoid what used to be unwanted extrusive effects in conventional mechanics, how to effect what was previously difficult intrusion, effecting extrusion, implant positioning for proper force vectors, indirect use of anchors, force thresholds, possible orthopaedic effects, the advantage of using 'force-driven' mechanics over 'shape-driven' mechanics, how TADs extend Graber's classical envelopes of tooth movement, non-surgical correction of vertical excess, whole arch distalisation to avoid extractions for moderate crowding and en masse arch movement to correct dental midline discrepancies. There are many case illustrations in this chapter (28 references)

Chapter 7 reveals a novel paradigm that totally changes some orthodontic concepts. In 1900, Angle's paradigm was of a static occlusion; in the 1980s and 1990s Proffit's was of a soft and hard tissue environment limited by 'envelopes' of tooth movement. Now TADs stretch all limits of previous envelopes of treatment. 'Loss of anchorage' is no longer a limit; it does not exist. Molar intrusion by braces is easy, so that non-surgical treatment of severe open bite and gummy smiles is routine. Tooth displays (within the lip lines) can now be elevated or depressed, protracted, canted or retracted, and moved transversely or unilaterally without surgery. Our guides are now aesthetic, face-driven treatment goals in non-growing

patients, and are no longer bound by the limitations that existed prior to skeletal anchorage. Occlusal planes can be tipped according to the aesthetic goals of treatment. Leveling can be planned for occlusion, A-P and transverse occlusal plane, for gingival margins and for healthy alveolar bone heights. Our VTO is now a much more detailed calculation, since we have better control of more variables. The chapter contains an excellent review of these principles and of smile aesthetics with many case illustrations (60 references).

Chapter 8 details the new mechanical concepts needed for orthodontic appliances working in our new A-P anchorage paradigm. These include how to control tooth tip, torque, archform distortion and bowing, control of arch level and arch canting, bodily and en masse retraction and protraction of teeth, control of transverse and vertical bowing effects, midline deviations, molar distalisations and periodontal bunching problems. There is a detailed discussion of the force vectors needed for tooth movement. These vectors dictate the proper positioning of the mini-screws and lever arms. Inexperienced clinicians need to be cautious because with secure anchorage (compared with old paradigm mechanics) the wanted and unwanted tooth movements will be larger than without a mini-screw TAD. Typical issues include over retraction and over intrusion (implants are apical to the occlusal plane), plane canting, root resorption and pushing teeth out of the alveolar trough and out of attached mucosa (24 references).

Chapter 9, 'Vertical control', demands a very detailed appreciation of the force vectors acting on teeth axes in all in three dimensions, as well as in the incisal A-P positions and occlusal planes. Archwires designed for tooth intrusion will normally extrude adjacent teeth (because much less force is needed for this), unless a mini-implant anchor is added to the system. The position of a TAD will influence the outcome. The efficiency of the mechanics varies with distance from a TAD to the target teeth. 'Force-driven' mechanics work more efficiently than 'shape-driven' mechanics, but the side-effects need to be controlled. Monitoring of the periodontium, root resorption, torque, tip, arch symmetry and facial change are important. Incisor extrusion without increasing the facial vertical dimension (formerly a difficult manoeuver) can now be achieved when implants bolster the anchor teeth. Control of incisor tipping (that accompanies intrusion - extrusion) must be planned into the mechanics. Molar intrusion is a three-dimensional exercise needing mindful control of the tilt of the occlusal plane, molar vertical position, molar tip and torque, molar axis, centre of rotation of the segment being intruded and the root areas of the teeth to be moved. All these things will be changed by intrusive forces from implants, so control needs to be planned. Single force intrusive vectors can be joined with continuous arch mechanics to help cancel side-effects from each force system. Cross-arch splinting will control movement of the upper molar roots, but it reduces efficiency. Cross-arch splinting requires palatal and buccal implants and for both first and second molars to be splinted, but it prevents unilateral intrusion which needs its own type of special

planning. Positioning an implant and force system as far posteriorly as possible is a key to successful control of the second molar palatal cusp and intrusion. Lower molar intrusion is especially difficult due to dense bone and limited sites for implants. Second molars need greater intrusion, but the bone in the area is often inadequate or inaccessible. Therefore, to control the second molars, indirect anchorage must be used with torque from the buccal. For controlling A-P tipping of an occlusal plane, two implants set apart are needed. Lingual mandibular implants are possible, but very difficult. Molar extrusion requires push mechanics off the implants. If used unilaterally this can correct occlusal plane canting (32 references).

Chapter 10 discusses transverse control. Asymmetrical maxillary crossbite and scissor-bite are situations where mini-implants can assist by bolstering anchorage on the side needing expansion or contraction. Single force mechanics to individual or small groups of teeth that need uprighting are very effective (22 references). Chapter 11 covers pre-prosthetic orthodontic preparation. Mini-implants provide anchorage regardless of the condition of the dentition. This final chapter illustrates the usefulness of creating space for prostheses, for periodontal improvement and for alveolar bone augmentation through tooth movement. Mini-screw implants are especially useful for the precise control required of anchor teeth (12 references).

This book is an exquisitely designed and illustrated assistant to the use of the new orthodontic mini-implant technology. It is a timely arrival because the technology is new and poorly understood by many in the profession. The technology promises good things, but unfortunately it has instead delivered much frustration to its users. Thankfully, remedies to many of the problems are given in this book. The book has two basic themes. The first is the biological, mechanical theory and material design concepts, which are based on considerable scientific and engineering knowledge. The second theme is the practical and clinical application of this knowledge. There are many high quality, detailed and annotated sketches and clinical photographs. It is also the best book on mechanotherapy I have read.

The book illustrates the design concepts embodied in the 'Orlus' implant system exclusively, in which some of the authors may have a financial interest. This fact does not detract in the slightest from the value contained in the book. Although very high failure rates are frequently reported, the authors claim very low failure rates when observing their principles and use of materials. It is a very significant contribution to the field of mini-implants.

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