CHAPTER 2

Literature Review

The review is divided into four parts as follows

2.1 Anatomical structure of the interradicular areas

2.2 Dentoalveolar compensation in skeletal discrepancies

2.3 Cone Beam Computed Tomography (CBCT)

2.4 Miniscrew implants

2.1 Anatomical structure of the interradicular areas

The interradicular space is the bony septum that divides one tooth socket from another. It is part of the alveolar process. The alveolar processes are portions of maxilla and mandible that surrounds and supports the roots of the teeth. The form of the alveolar process is related to the functional demands put upon the teeth and also corresponds to the surfaces of the roots of teeth supported by it. It is maintained by the presence of the teeth. When the teeth are lost, the alveolus resorbs. The alveolar process includes the buccal and lingual cortical plates, the alveolar crest, the trabecular bone, and the alveolar bone proper.[18, 19]

The cortical plate is composed of buccal and palatal/lingual plates of compact bone. It is dense in nature. It provides strength and protection. The alveolar crest is the highest point of the alveolar ridge and joins the buccal and palatal/lingual cortical plates. Trabecular or spongy bone lies within the central portion of the alveolar process, and consists of less dense, cancellous bone. Finally, the alveolar bone proper is a thin layer of compact bone, that is recognized on a dental radiograph as a white line, called the lamina dura.[18, 19]

The insertion of a miniscrew implant in this maxillary buccal interadicular area carries a risk that the miniscrew implant may damage anatomic structures, such as the dental roots, and cause perforation of the maxillary sinus and nasal cavity.[3, 8, 11, 20, 21] In the mandibular area, the limitation of miniscrew implants in the interraducular area concerns the risk of damage to anatomic structures, such as dental roots, blood vessels, and nerves.[12]

Blood vessels and nerves can be injured during miniscrew implant placement. However, it has rarely occurred as vessels and nerves generally lie away from insertion sites. The inferior alveolar nerve and artery and the mental nerve and artery are the important landmarks when considering placing miniscrew implants in this area.[22] The inferior alveolar nerve and artery enter the mandibular foramen at the center of the medial surface of the ramus and proceed anteriorly in the mandibular canal. They traverse the mandible from the lingual to the buccal side. They are midway between the buccal and lingual cortical plates in the first molar vicinity. In the molar region, the inferior alveolar nerve usually divides into the mental and incisal nerves. In the mental canal, the mental nerve continues upward and emerges from the mental foramen in conjunction with blood vessels. Medial to the mental foramen, studies have confirmed the existence of a true incisive canal, which is a continuation of the mandibular canal. The incisive canal may also appear to be ill-defined, and neurovascular bundles may run through a labyrinth of intertrabecular spaces.[18, 23]

The mental foramen is usually located apical to the second mandibular premolar or between the apices of the premolars. Minor variations may be race related. For instance, among Chinese subjects, the mental foramen is usually located apical to the second premolar, whereas in Caucasian subjects, it is usually found between the premolars. Atypically, it can be found anteriorly by the canine or posteriorly by the first molar. In the vertical plane, it is usually found more coronal than the mandibular canal and usually found halfway between the alveolar crest and the inferior border of the mandible. However, this finding could be influenced by the amount of crestal bone loss.[23] Monnerat *et al.*[12], in both tomographic measurements and the assessment of mandibular slices with implants already in place at interradicular spaces, observed a considerable distance from the alveolar crest to the mental foramen (12.4 ± 3.25 mm), and the risk of damage to the mental nerve was therefore ruled out. Nevertheless, caution is advised when placing miniscrew implants between the mandibular premolars, particularly starting at a distance of 9 mm from the bone crest. However, because of wide individual variability, each patient should be carefully evaluated.

To prevent damage to adjacent structures when placing an orthodontic miniscrew implant, a certain safety distance is required. The safety distance ranges from 0.5 mm and 2.0 mm. Liou *et al*.[24], recommending a 2.0 mm safety distance, found that the average movement of an orthodontic miniscrew implant was 0.5 mm at the implant head. Poggio *et al.*[16], studying the safe zone, assumed that a minimum clearance of 1.0 mm of alveolar bone around the miniscrew implant could be sufficient for periodontal health. Maino *et al.*[25] recommended 0.5 mm as the minimal safety distance to any adjacent anatomical structure. Therefore, if the accepted safety distance is 1.0 mm, the required space for safe placement of miniscrew implant with a maximum diameter of 1.5 mm would be at least 3.5 mm.[16]

Cortical bone has a higher modulus of elasticity than does trabecular bone, is stronger and more resistant to deformation, and will bear more load in clinical situations than trabecular bone. Greater miniscrew-bone contact has better primary stability. Without injuring any vital structure, the miniscrew should be inserted as deep as possible to increase its biting depth and therefore miniscrew-bone contact.[26] However, some studies could not detect the association between primary stability or long-term success and miniscrew implant length.[2, 4] The stability might largely depend on cortical bone thickness rather than implant length.[4] Therefore, thicker cortical bone provides greater primary stability.[7] Miyawaki *et al.*[2] concluded that a high mandibular plane angle, which is often present in thin cortical bone, was associated with miniscrew implant failure. Sufficient mechanical interdigitation between the screw and the cortical bone is an important factor that affects the stability of the miniscrew implant. Motoyoshi *et al.*[27] investigated the relationship between cortical bone thickness and the success rate of miniscrew implants placed in buccal alveolar bone of the posterior region. The findings indicated that to achieve successful implantation the prepared site should be established in an area with a cortical bone thickness of more than 1.0 mm.

Several articles have attempted to report the availability of the interradicular space for miniscrew implant placement. Schnelle *et al*.[28] evaluated the availability of bone for placement of miniscrew implants by using the pre-treatment and post-treatment panoramic radiographs of 30 orthodontic patients. They reported that adequate bone for placement, 3-4 mm interradicular distance, was located more than halfway down the root length, which typically would be covered by movable mucosa.

Chaimanee *et al.*[11] examined the influence of different dentoskeletal patterns on the availability of interradicular spaces and determined the safe zones for miniscrew implant placement using periapical radiographs of 60 subjects with skeletal Class I, II, or III patterns. For all skeletal patterns, in the maxilla, the greatest interradicular space was between the second premolar and the first molar. In the mandible, the greatest interradicular space was between the first and second molars, followed by the first and second premolars. In addition, the availability of interradicular space was mainly influenced by the axial inclination of teeth due to dentoalveolar compensatory changes for variations in sagittal skeletal discrepancies. Maxillary interradicular spaces, particularly between the first and second molars, in the subjects with skeletal Class II patterns, were greater than those in the subjects with skeletal Class III patterns. In contrast, in the mandible, interradicular spaces in the subjects with skeletal Class III patterns were greater than those in the subjects with skeletal Class II patterns.

Hu *et al.*[17] analyzed the cross sections of 20 maxillae and mandibles at 1 mm intervals from cervical line to the root apex. They found that the interradicular distance increased from anterior to posterior teeth and from the cervical line to the root apex in both the maxilla and the mandible. In the maxilla, the greatest interradicular distance was between the second premolar and the first molar. In the mandible, the greatest interradicular distance was between the first and second molars. The maxillary buccal cortical bone was thicker in the posterior than in the anterior region, but the difference was small and the thickness did not change from the cervical line to the root apex. The mandibular cortical bone thickness increased from anterior to posterior regions and from the cervical line to the root apex. The change in bone thickness was greater in the posterior than in the anterior region. The cortical bone thickness was greater in the mandibular arch in the posterior region. The safest zone for placement of a miniscrew in the maxilla was between the second premolar and the first molar, from 6 to 8 mm from the cervical line. The safest zone for placement of a miniscrew in the mandible was between the first and second molars, less than 5 mm from the cervical line.

Monnerat *et al.*[12] assessed the amount of mandibular interradicular space in 15 dry human mandibles using computed tomography. The buccal cortical bone thickness, and the buccolingual and interradicular distances increased from the cervical to the apical aspects. The widest interradicular spaces were found, in descending order, between the first and second molars, between the second premolars and the first molars, and between the first and second premolars.

Baumgaertel *et al.*[7] studied 30 dry skulls by cone-beam computed tomography scans showed that buccal cortical bone thickness was greater in the mandible than in the maxilla. This buccal cortical bone thickness increased with increasing distance from the alveolar crest in the mandible, whereas those in the maxilla was thickest at the 6-mm level and thinnest at the 4-mm level.

Poggio *et al*.[16] determined safe zones for miniscrew implant placement from volumetric tomographic images of 25 maxillae and 25 mandibles. They reported that in the maxillary buccal region, the greatest amount of interradicular bone was between the second premolar and the first molar, 5.0 to 8.0 mm from the alveolar crest. In the mandibular buccal region, they found that the greatest amount of interradicular bone was either between the first and second premolar, or between the first and second molar, approximately 11 mm from the alveolar crest.

Park and Cho[4] using cone beam volumetric imaging, studied 60 adult patients (30 men, 30 women) and measured interradicular space, thickness of cortical bone, and alveolar process width at prospective miniscrew implant placement sites. They reported that the maxillary interradicular distances tended to increase from the cementoenamel junction to the apex and safe locations for miniscrew implant placements with adequate interradicular space were between the second premolar and the first molar in the maxillary buccal alveolar bone, and interradicular spaces from the first premolar to the second molar in the mandibular buccal alveolar bone. Mandibular interradicular distances tended to be greater than maxillary interradicular spaces. In both jaws, buccal cortical bone thickness tended to increase from the cemento-enamel junction to the apex and the cortical bone thickness in the posterior mandibular interradicular area can be expected to be 1 mm or more.

Fayed *et al*.[6] studied cone beam computed tomographic images of 100 patients (46 males, 54 females). In the maxilla, the highest buccolingual thickness existed between first and second molars, the highest buccal mesiodistal distances were between the second premolar and the first molar, and the highest buccal cortical thickness was between the first and second premolars. In the mandible, the highest buccolingual and buccal cortical thicknesses were between the first and second molars. The highest buccal mesiodistal distance was between the second premolar and the first molar.

2.2 Dento-alveolar compensation in skeletal discrepancies

Dentoalveolar compensation refers to the process or mechanism by which the development of dental and alveolar arches are controlled so as to secure occlusion of the teeth and adaptation to the basal parts of the jaws. During facial development, full compensatory occlusal development enables normal occlusion despite some variations in skeletal relationships, whereas, in contrast, insufficient compensatory guidance of tooth eruption can lead to malocclusion.[29]

This compensation phenomenon is related to the skeletal imbalance and to the intermaxillary bone relations, designed to achieve dental occlusion. The dentoalveolar compensatory reaction is dependent on and also works in direct connection with the surrounding muscles, temporomandibular joint and force of occlusion.[30, 31]

For existing sagittal jaw discrepancies, compensatory inclination of the maxillary and mandibular incisors results in normal incisal relationships.[30] Excessive proclination of the mandibular incisors and retroclination of the maxillary incisors were observed in the patients with skeletal Class II discrepancies. In contrast, retroclination of the mandibular incisors combined with proclination of the maxillary incisors were observed in the patients with skeletal Class III discrepancies.[11, 30]

Dentoalveolar compensation includes not only different horizontal adjustments but also different vertical developments of the dentition which induce rotational changes of the occlusal plane. When the mandible grew more than did the maxilla, the growth difference was mostly absorbed by the mesial displacement of the maxillary first molar and the counterclockwise rotation of the occlusal plane. Anterior occlusion was adjusted by the mesial displacement and the labial inclination of the maxillary incisors and the lingual inclination of the mandibular incisors. When the maxilla grew more than did the mandible, the growth difference was mainly absorbed by the mesial displacement of the mandibular molars. The maxillary molar showed minimal mesial displacement. The occlusal plane also showed minimal rotational change. Anterior occlusion was adjusted by lingual tipping of the maxillary incisors and mesial displacement and labial tipping of the mandibular incisors. However, the maxillary first molars may be under greater influence by the dentoalveolar compensation than are the mandibular first molars.[32]

Moreover, the dentoalveolar compensation observed in different skeletal patterns played an important role in the availability of interradicular space. The availability of interradicular space was mainly influenced by the axial inclination of teeth due to dentoalveolar compensatory changes for variations in sagittal skeletal discrepancies. Therefore, the teeth with greater inclination present with less interradicular space, whereas more upright teeth present more interradicular space.[11]

2.3 Cone Beam Computed Tomography (CBCT)

Accurate diagnostic imaging is an essential requirement to derive the correct diagnosis and optimal treatment plan, as well as to monitor and document the treatment progress and final outcome. Two-dimensional (2D) radiographic imaging has been a part of the orthodontic patient record for decades.[14] However, the limitations in analysis of these imaging modalities are well known, and include magnification, geometric distortion, superimposition of structures, projective displacements (which may elongate or foreshorten an object's perceived dimensions), rotational errors and linear projective transformation.[14, 15, 33]

Therefore, there has been an increasing interest in three-dimensional (3D) imaging technique and it has changed the professional approach diagnosis in dentistry and in orthodontics. Although conventional or traditional medical computed tomography (CT) is still used in many clinical situations when 3D information is needed, its use has been limited in dentistry because of cost, access, and dose considerations.[15, 34, 35] Since, CBCT was developed in the late 1990s, it has been specifically dedicated to imaging the maxillofacial region, as a true paradigm shift from a 2D to a 3D approach to data acquisition and image reconstruction. It has created a revolution in maxillofacial imaging, facilitating the transition of dental diagnosis from 2D to 3D images and expanding the role of imaging from diagnosis to image guidance of operative and surgical procedures by way of the applications software.[14, 15, 35]

2.3.1 Principles of CBCT

CBCT imaging is accomplished using a rotation in which a divergent pyramidal or cone shaped X-ray beam is directed from one side of the machine, through the center of the region of interest (ROI) onto an area X-ray detector on the opposite side. The X-ray source and detector rotate around a rotation fulcrum fixed within the center of the ROI. During the rotation, multiple (from 150 to more than 600) sequential projection images of the field of view (FOV), selected according to the ROI, are acquired by a rotational scan exceeding 180 degrees. This varies from a conventional CT, which uses a fan shaped X-ray beam in a helical progression to acquire individual images of axial slices of the FOV and then stacks the slices to obtain a 3D representation. Therefore, each slice requires a separate scan. Because CBCT exposure incorporates the entire FOV, only one rotational scan is necessary to acquire enough data for image reconstruction.[15, 36]

During CBCT rotation, single exposures are made at certain degree intervals, providing projection images, known as basis or projection images. These are similar to lateral cephalometric radiographic images, each slightly offset from one another. The complete series of images is referred to as the projection data. The number of images comprising the projection data depends on the system and settings applied. Reconstruction software programs incorporating sophisticated algorithms are applied to these projection data to generate a 3D volumetric data set, which can be used to provide secondary reconstruction images in three orthogonal planes (axial, sagittal and coronal). The resolution, and therefore detail, of CBCT imaging is determined by the individual volume elements or voxels produced from the volumetric data set. In CBCT imaging, voxel dimensions primarily depend on the pixel size in the area detector. The size of these voxels determines the resolution of the image. In conventional CT, the voxels are anisotropic, rectangular cubes, where the longest dimension of the voxel is the axial slice thickness. Although CT voxel surfaces can be as small as 0.625 mm square, their depth is usually in 1-2 mm. However, all CBCT units provide voxel resolutions that are isotropic, equal in all three dimensions. This produces sub-millimeter resolution, ranging 0.076 mm to 0.4 mm.[15, 36-38]

2.3.2 Advantages of CBCT

Since CBCT provides images of highly contrasting structures, it is particularly well-suited for the imaging of osseous structures of the craniofacial area.[15, 37] The use of CBCT technology in clinical dental practice provides a number of advantages for maxillofacial imaging compared with conventional CT:

1) Size and cost

A CBCT unit has a greatly reduced size and is approximately 20-25% of the cost of conventional CT. Both these features make it available for the dental office.[15, 36]

2) X-ray beam limitation

Reducing the size of the irradiated area by collimation of the CBCT primary x-ray beam enables limitation of the x-radiation to scan small regions for specific diagnostic tasks. Therefore an optimum FOV can be selected for each patient based on suspected disease presentation and ROI. Although not available on all CBCT systems, this functionality is highly desirable, as it provides dose savings by limiting the irradiated field to fit the FOV.[15, 37]

3) Image accuracy

CBCT imaging produces images with sub-millimeter "isotropic" voxel resolution, ranging from 0.4 mm to as low as 0.076 mm. Because of this characteristic, subsequent secondary (axial, coronal and sagittal) and multiplanar reformation (MPR) images achieve a level of resolution that is accurate enough for measurement in maxillofacial applications, where precision in all dimensions is important, such as implant site assessment and orthodontic analysis.[15]

4) Rapid scan time

Because CBCT acquires all basis images in a single rotation, scan time is rapid (10–70 seconds) and comparable with that of conventional CT systems. Although faster scanning time usually means fewer basis images from which to reconstruct the volumetric data set, motion artifacts due to subject movement are reduced.[37]

5) Reduced patient radiation dose

Published reports indicate that the effective dose varies for various CBCT device, FOVs and selected technique factors, ranging from 51.7 to 1025.4 μSv.[39] Comparing CBCT with conventional CT systems, conventional CT dose is from 1.5 to 12.3 times greater than comparable medium-FOV dental CBCT scans.[40] However, CBCT system doses are several times higher than those from conventional panoramic imaging.[39]

6) Interactive display modes applicable to maxillofacial imaging

Access and interaction with conventional CT data are not possible, as workstations are required. Although such data can be converted and imported into proprietary programs for use on personal computers, this process is expensive and requires an intermediary stage that can extend the diagnostic phase. Reconstruction and viewing of CBCT data is performed natively by using a personal computer; therefore it provides the clinician with the opportunity to use chair-side image display and real-time analysis. CBCT provides images demonstrating features in 3D that intraoral, panoramic and cephalometric images cannot. It reconstructs the projection data to provide inter-relational images in three orthogonal planes (axial, sagittal and coronal). In addition, the availability of cursor-driven measurement algorithms provides the clinician with an interactive capability for real-time dimensional assessment, annotation, and measurement. Because of its isotropic nature, the volumetric dataset provides dimensions free from distortion and magnification, and can be sectioned non-orthogonally. Such non-orthogonal sectioning is referred to as MPR. Such MPR modes include oblique, curved planar reformation (providing “simulated” distortion free panoramic images) and, serial trans-planar reformation (providing cross sections), all of which can be used to highlight specific anatomic regions and diagnostic tasks.[15, 36, 37]

2.3.3 Applications of CBCT imaging in orthodontics

CBCT has increasingly become an important source of 3D data in clinical orthodontics. It is recommended in specific cases, in which conventional radiography cannot supply satisfactory diagnostic information, and its use has been substantiated to enhance diagnosis and treatment planning and in which its benefits exceed the risks from radiation dose.[14] The following types of cases could benefit from CBCT images:

1) Anomalies of teeth and roots

Impacted and transposed teeth are possibly the most common reason for use of CBCT imaging in orthodontics. The information can enhance the ability to localize these teeth, identify pathological conditions, such as ankylosis and dilacerations, and root resorption, and can help in treatment planning.[14]

2) Boundary conditions

The dentoalveolar anatomy establishes the boundary conditions during orthodontic tooth movement and the final positioning of teeth. For orthodontic treatment purposes, the boundary conditions may be defined as the amount (depth and height) and morphology of the alveolar bone relative to tooth root dimensions, angulation and position. Boundary conditions may also complicate situations in which a transposed tooth needs to be moved back to its appropriate location, alveolar bone morphology that clinically appears too narrow to accommodate significant labiolingual or buccolingual displacements or angulations of teeth, and the compromised periodontium or gingival anatomy. These anatomical boundary conditions may limit or dictate the planned or potential tooth movement as well as the final desired position and angulation of the tooth. Root anatomy, such as short or dilacerated roots, may also determine the amount and direction that a tooth can be moved. The visualization and characterization of these boundary conditions is best performed by analyzing volumetric CBCT information.[14]

3) TMJ degeneration, progressive bite changes and functional shifts

TMJ pathoses that result in alterations in the size, form, quality and relationships of the osseous joint components often cause adverse clinical manifestations, progressive bite changes and lead to malocclusion. These changes are difficult to characterize accurately with 2D radiographic imaging. In contrast, by allowing the concurrent visualization of TMJs, the maxillomandibular relationships and occlusion, CBCT images provide clinicians with the opportunity to visualize and quantify the local and regional effects associated with TMJ abnormalities.[14]

4) Dental implant and miniscrew implant placement

CBCT imaging can provide valuable information for the placement of dental implants and miniscrew implants. The evaluation of the quantity and quality of bone from CBCT scans may help in identifying optimal implant sites, thereby enhancing the chances of success. CBCT scans can also provide useful visualization of adjacent structures, such as tooth roots, and can be valuable for avoiding damage.[14]

2.4 Miniscrew implants

2.4.1 Components of miniscrew implants

The miniscrew implant can be divided into three parts, the head, transmucosal collar or neck, and body (Figure 2.1).[8, 41, 42] The head is available in different designs to be used with auxiliary devices, such as coil springs, elastics, or ligature wires.[1, 42] The transmucosal collar is the component that lies between the body and the head. It abuts against the outer cortical bone and contacts the soft tissue. So, it should be smooth. Its length elevates the head to prevent soft tissue impingement from elastics or coil springs. The different collar lengths are for the different miniscrew implant placement sites, depending on soft tissue thickness.[8, 41, 43] The body is wrapped around with the thread or helix. The diameter of the miniscrew implant is measured either at inner diameter, which does not include the thread, or including the thread (outer diameter), depending on the manufacturers.[8] The diameter and length of the miniscrew implant are the main features to consider when selecting a miniscrew implant. The body is tapered in shape more commonly, for safety reasons, than parallel, because its end is thinner, with less risk of touching the root surface. Miniscrew implants are available in pre-drilling and self-drilling types.[42] Pre-drilling miniscrew implants have blunt tips and it is necessary to drill a pilot hole before their insertion into the bone. Self-drilling miniscrew implants have a sharp cutting tip and can be directly inserted into the bone.[44] The threaded bodies have different diameters and lengths for different miniscrew implant placement sites.[41]

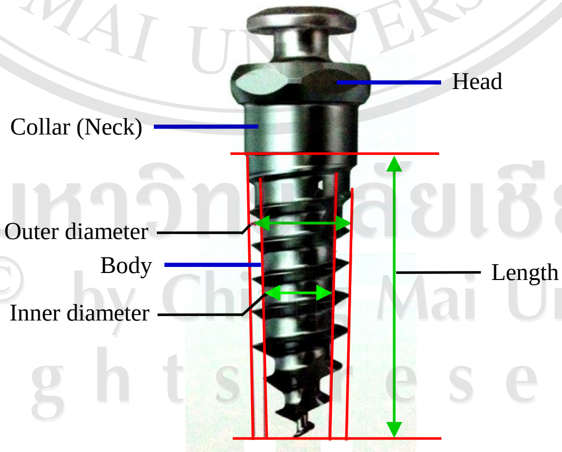

Figure 2.1 Components of miniscrew implant

2.4.2 Diameters of miniscrew implants

Most miniscrew implants have a thread diameter ranging from 1.2 to 2.0 mm.[1, 8] In general, the most frequently reported diameters are 2.0 mm, 1.2 mm, and 1.6 mm, respectively.[44]

The diameter of the miniscrew implant has been reported to be one of the most important factors related to stability and loosening of miniscrew implants.[2] Miniscrew implants with large diameters result in increased implant-bone interface, resulting in improved primary stability.[2, 26, 44] Moreover, increased size of miniscrew implants prevents risks of miniscrew fracture during insertion or removal procedures.[44]

However, larger miniscrew implant diameters may pose problems with penetration of adjacent anatomical structures, particularly placement in limited areas, such as the dentoalveolar bone; the amount of interradicular space plays an important role in the selection of the appropriate diameter used.[44] Decreased diameter facilitates insertion to sites with root proximity without the risk of root contact. Nevertheless, a major concern regarding the diameter of the miniscrew implants is the increased numbers of fractures noted in diameters less than 1.2 mm.[1]

The diameter of the miniscrew implant is restricted by the available interradicular space. The recommended diameter of miniscrew implant to be placed in interradicular spaces is 1.2 to 1.6 mm. This depends on the location and the availability of interradicular space.[4] Miyawaki *et al*.[2] suggested that miniscrews with a diameter of 1.5 mm should be used in patients with thick cortical bone and that miniscrews with a diameter of more than 2.3 mm should be used in patients with thin cortical bone. Due to the possibility of injury to proximal tooth roots, Deguchi *et al.*[45] recommended the use of screws less than 1.5 mm in diameter for placement on the buccal alveolar bone in the posterior region. Liou *et al*.[41] suggested that the 1.5 mm diameter miniscrew implant should be used in interradicular areas.[41]

To avoid root contact and to ensure stability after placement, miniscrew implants should be used in a region with sufficient cortical bone thickness and bone quality; however, in a region with fragile bone, wide screws are preferred.[27]

2.4.3 Lengths of miniscrew implants

Most miniscrew implants have a thread length ranging from 4.0 to 12.0 mm, although some of them are also available at lengths of 14, 17 or even 21 mm.[1] In general, the most frequently used miniscrew lengths are 8.0 mm , 6.0 mm, and 9.0 mm, respectively.[44]

Miniscrew implants are available in different lengths to accommodate placement in different regions. Costa *et al.*[46] reported that miniscrew implants of 4.0 to 6.0 mm in length are safe in most regions, but individual patient variation dictates individual evaluation of bone depth in all patients. Due to the possibility of injury to proximal tooth roots, Deguchi *et al.*[45] recommended the use of screws shorter than 6 mm for placement on the buccal alveolar bone in the posterior region. Torut *et al*.[44] reported that the most frequently used lengths of miniscrew implants in the dentoalveolar bone were 8.0 mm, 6.0 mm, and 9.0 mm, respectively. Park and Cho[4] recommended lengths of 6.0 to 7.0 mm for both safety and stability. To achieve maximum contact with cortical bone, Paik *et al.*[8] recommended using a 6 mm length in the buccal alveolar bone. Park and Cho[4] recommended lengths of 6.0 to 7.0 mm for both safety and stability.

It might seem logical that a longer implant can provide greater stability because of a greater surface area contacting the bone. However, no conclusive evidence exists whether implant length is a decisive factor for primary stability or long-term success.[2, 4] In addition, stability is affected more by cortical bone thickness than by the length of miniscrew implant.[17] Moreover, a longer miniscrew implant has a higher likelihood of damaging adjacent structures. Miniscrew length should be determined after considering the thickness of both the soft tissue and the cortical bone at the site of placement. Regular length miniscrew implants should be used in the buccal alveolar bone and long screws should be used in areas with thick mucosal tissue.[2, 10] Therefore, it is important to place the optimally designed miniscrew implant in the correct position, and a shorter miniscrew implant should be preferred over a longer implant.[2, 27]