ORIGINAL ARTICLE

# Factors affecting the clinical success of screw implants used as orthodontic anchorage

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**Introduction:** The purposes of this study were to examine the success rates and find factors affecting the clinical success of screw implants used as orthodontic anchorage. **Methods:** Eighty-seven consecutive patients (35 male, 52 female; mean age, 15.5 years) with a total of 227 screw implants of 4 types were examined. Success rates during a 15-month period of force application were determined according to 18 clinical variables. **Results:** The overall success rate was 91.6%. The clinical variables of screw-implant factors (type, diameter, and length), local host factors (occlusogingival positioning), and management factors (angle of placement, onset and method of force application, ligature wire extension, exposure of screw head, and oral hygiene) did not show any statistical differences in success rates. General host factors (age, sex) had no statistical significance. Mobility, jaw (maxilla or mandible), and side of placement (right or left), and inflammation showed significant differences in success rates. Mobility, the right side of the jaw, and the mandible were the relative risk factors in the logistic regression analysis when excluding mobility, inflammation around the screw implants was added to the risk factors. **Conclusions:** To minimize the failure of screw implants, inflammation around the implant must be controlled, especially for screws placed in the right side of the mandible. (Am J Orthod Dentofacial Orthop 2006;130:18-25)

Anchorage control is an important factor in the success of orthodontic treatment. There have been many attempts to devise suitable anchorage methods, including intraoral and extraoral appliances. All intraoral appliances, however, show some loss of anchorage. Extraoral appliances do not provide reliable anchorage without patient compliance.

When using skeletal anchorage such as osseous dental implants, miniplates,[1] miniscrews,[2,3] or microscrews,[4-7] clinicians can expect reliable anchorage without patient compliance. Among these anchorage devices, microscrew implants have increasingly been used for orthodontic anchorage because of their absolute anchorage, easy placement and removal, and low cost. The small size of microscrew implants allows them to be placed into bone between the teeth, thus expanding their clinical applications.[4-7] With more patients treated with screw implants as anchorage, their stability is gathering attention.

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The success of dental implants has been studied extensively. Miniscrew or microscrew implants, however, used as orthodontic anchorage should be loaded early to reduce treatment time and should be removed after treatment. In addition, microscrew implants are normally placed below or above the roots or between the roots of the teeth, or in the palatal or retromolar area, whereas dental implants are placed in the edentulous ridges. Patients receiving dental implants are generally older than patients who have them for orthodontic purposes. Therefore, factors affecting the clinical success of dental implants might not be associated with miniscrew or microscrew implants for orthodontic anchorage. Miyawaki et al[8] and Cheng et al[9] studied the stability of screw implants for orthodontic purposes. These studies mostly dealt with factors affecting the stability of miniscrews (over 1.5 mm in diameter) and miniplates. The use of microscrew implants has now been expanded, but there are still many unknown factors that could affect the clinical success of miniscrew or microscrew (less than 1.2 mm in diameter) implants.

The purposes of this study were to find factors related to the clinical success of miniscrew and microscrew implants and to examine the success rates of various types of microscrew and miniscrew implants.

## MATERIAL AND METHODS

The sample consisted of 87 consecutive patients (35 male, 52 female; mean age, 15.5 years; SD, 8.3 years) who received miniscrew or microscrew implants as

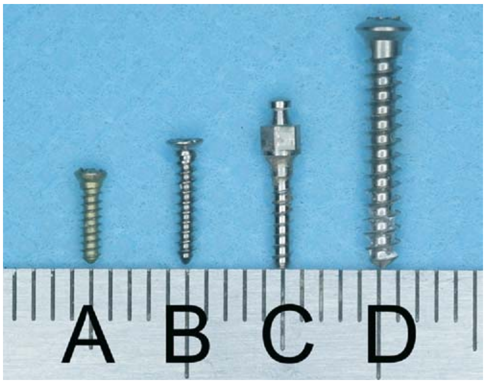


**Fig 1.** Four types of screw implants used in study.

orthodontic anchorage. The patients were informed of the advantages and disadvantages of this procedure. After collecting informed consent from the patients, the implants were placed.

Four types of screw implants (total, 227) were used in this study: 19 type A microscrews (Stryker Leibinger Inc, Kalamazoo, Mich) (diameter, 1.2 mm; length, 5 mm); 157 type B microscrews (Osteomed, Addison, Tex) (diameter, 1.2 mm; length, 6, 8, or 10 mm); 46 type C microscrews (Absoanchor, Dentos, Daegu, Korea) (diameter, 1.2 mm; length, 4, 6, 7, 8, or 10 mm), and 5 type D miniscrews (KLS-Martin, Jacksonville, Fla) (diameter, 2 mm; length, 10, 12, 14, or 15 mm) (Fig 1, Table I). The type C microscrew implants were developed for orthodontic purposes, with special features for attaching elastic materials.

The surgical procedure included local anesthesia, a small vertical stab incision (3-4 mm), reflection of flaps, a pit made with a round bur, a hole made with a pilot drill, and placement of the screw implants with a screwdriver. Surgical placement of the various screws followed the same procedure according to previous reports.[5-7] The screws were placed and checked by 1 doctor (H-S.P.). The screw implants were placed at 30° to 40° angles to the long axes of the teeth in the maxillary arch and at 10° to 20° angles in the mandibular posterior area. The screw implants in the retromolar area and the distobuccal bone to the mandibular second molars were placed at 90° to the bone surface. The reason for placing the screw implants at those angulations was to reduce root contact by the screw implants without reducing the length of the screw. A long screw might have increased stability, and an angled screw provides more bone contact than a screw placed perpendicular to the bone. Just after placement, the initial stability of the screw implant was checked; there was no sign of mobility.

**Table I.** Success rate, number of patients and implants, and sizes of implants

| | *Type of miniscrew or microscrew implant* | | | |
|---|---|---|---|---|
| | *A* | *B* | *C* | *D* |
| Success rate (%) | 84.2 | 93.6 | 89.1 | 80.0 |
| Patients (n) | 10 | 67 | 16 | 4 |
| Screw implants (n) | 19 | 157 | 46 | 5 |
| Success (n) | 16 | 147 | 41 | 4 |
| Size of screws (mm) | | | | |
| Diameter | 1.2 | 1.2 | 1.2 | 2.0 |
| Length (n) | 5 (19) | 10 (10) | 10 (7) | 15 (2) |
| | | 8 (77) | 8 (4) | 14 (1) |
| | | 6 (70) | 7 (2) | 12 (1) |
| | | | 6 (15) | 10 (1) |
| | | | 4 (18) | |

*P* = .154, Fisher exact test.

### Clinical variables

To prevent examiner bias, 18 clinical variables were investigated by the same doctor (H-S.P.). The variables were divided into 3 categories: screw implant factors, host factors, and management factors. Screw implant factors included type, length, and diameter of the screw implants. Host factors were related to age and sex. Local host factors at recipient sites included jaw in which the screws were placed, side of screw placement (right or left), sites of placement, and occlusogingival positioning of the screw implants. Procedure management factors referred to angle of placement, method of force application, onset of force application, duration of loading to screw implants, use of ligature extension, and exposure of the screw head. Environmental management factors were oral hygiene and inflammation around the screw implants. Mobility was checked during use.

According to occlusogingival positioning of the screws, the sample was divided into 4 groups: lower oral mucosa (screws in the lower oral mucosa and deep in the vestibule), upper attached gingiva (placed in the upper attached gingival zone), upper oral mucosa-low (placed in the upper oral mucosa up to 3 mm from the mucogingival line), and upper oral mucosa-high (placed high in the upper vestibule) (Fig 2). The lower oral mucosa and the upper oral mucosa-high groups had freely moving soft tissues at the site of placement, and the upper oral mucosa-low group had partly moving soft tissues around the screw implants. The upper attached gingiva group had firmly attached gingivae around the screw implants; this group included screw implants in the palatal alveolar area.

To assess the effect of site of placement on success, because bone density and cortical bone thickness vary,

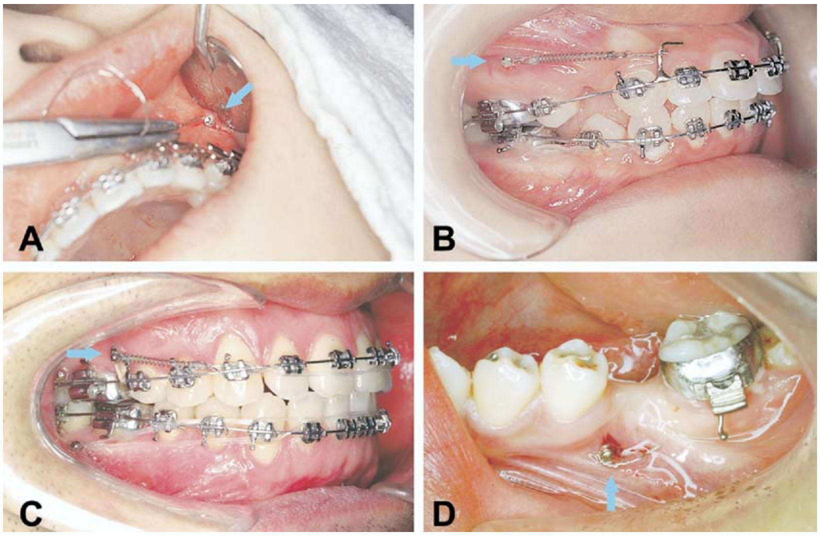


**Fig 2.** Occlusogingival position of micro-implant: *A,* upper oral mucosa-high; *B,* upper oral mucosa-low; *C,* upper attached gingiva; *D,* lower oral mucosa.

placement sites were examined and divided into 5 groups: (1) retromolar area, distobuccal to the lower second molar (LR and LD7), (2) buccal alveolar bone between the lower first and second molars (L67), (3) upper and lower anterior area (A), (4) buccal alveolar bone between the upper second premolar and the first molar, and between the upper first and second molars (U56 and U67), and (5) upper palatal alveolar bone between the first and second molars (UP) (Fig 3).

Three angulations were used: 10° to 20[3], 30° to 40°, and 90°. There were 4 methods of force application, with less than 200 g of force applied by (1) power chain, (2) Super thread (Rocky Mountain Orthodontics, Denver, Colo), (3) nickel-titanium coil spring, and (4) ligature tie-back. The sample was divided into 2 groups according to the ligature wire extension: yes or no. To attach the elastic materials, the ligature extension was connected to the neck of the screw implants when the screw head was expected to be covered by soft tissue. The exposure of the screws was either open or closed. If the head of screw was exposed in the mouth, the patients were included in the open group. Otherwise, they were included in the closed group.

To check the effect of oral hygiene on success, the amount of food debris and plaque accumulation on the tooth surfaces were assessed; the sample was divided into 3 groups: good, fair, or poor. Inflammation around the screw implant was checked in the following categories: yes or no. Redness or swelling around the neck of the screws was a sign of inflammation. Each patient was instructed to use a tooth brush to clean the teeth and a compressed water spray to clean the screw implants. If oral hygiene deteriorated, the patient was reinstructed to improve hygiene.

Mobility was checked with cotton tweezers at 5 to 8 months after placement. There were 3 groups: yes (mobile), no (not mobile), and unknown (impossible to check because of overlying soft tissue). If there was any discernible mobility, the screw implant was counted in mobile group.

Screw implants that were maintained in the bone to the end of treatment or to intentional removal regardless of mobility were considered successful. If the screw implants loosened during treatment, they were considered to have failed.

### Statistics

The overall success rate and the success rates for the type of screw implant and other clinical variables were calculated.

To compare the differences of the levels of success according to age, onset of force, duration of force application, and length of the screw implants, the Student *t* test was used. To compare the differences in the success rate according to the classification of each clinical variable, the chi-square or Fisher exact test was performed with a statistical analysis program (version 1.0, SPSS, Chicago, Ill). Logistic regression analysis was performed to estimate the influence of each factor on failure. The odds ratio of each factor for failure of the screw implants was calculated. The odds ratio represents the proportionate risk for failure of screw implants.

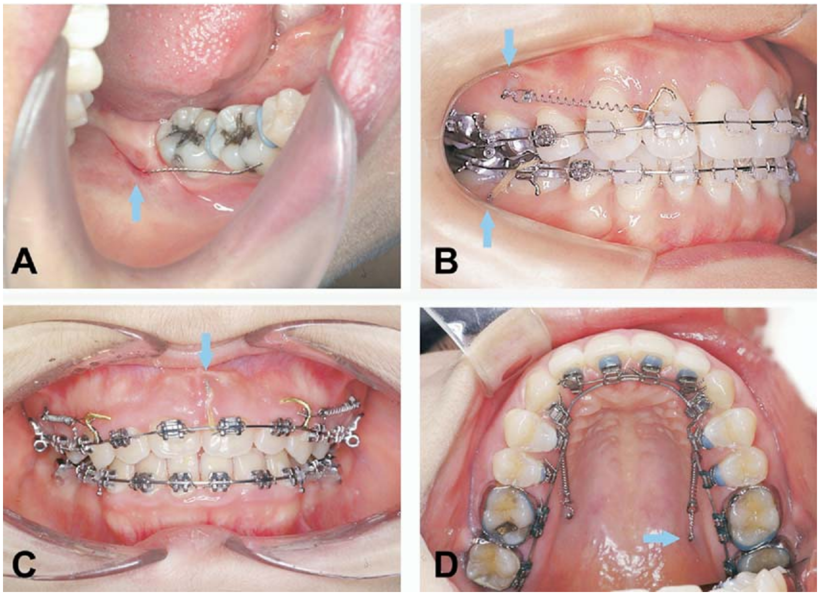


**Fig 3.** Sites of placement: *A,* retromolar area distobuccal to mandibular second molar; *B,* buccal alveolar bone between mandibular first and second molars, and buccal alveolar bone between maxillary second premolar and first molar, and between maxillary first and second molars; *C,* maxillary and mandibular anterior area; *D,* maxillary palatal alveolar bone between first and second molars.

## RESULTS

The overall success rate was 91.6% for all screw implants (208 of 227 screws) with a mean period of force application of 15 months. When the screw implants failed, new ones were placed into a neighboring area. Eleven of 19 screws that failed were replaced and were successful to the end of treatment.

The success rates for the types of screw implants were 84.2 % for type A, 93.6% for type B, 89.1% for type C, and 80% for type D. There were no significant differences in the success rates between the types of screw implants ($P = .154$), although the success rates for types B and C were higher than for types A and D (Table I). There were no statistically significant differences in the success rates between diameter and length of the screws.

For host factors, there were no significant differences according to age and sex (Tables II and III). For the local host factor, the screw implants placed in the maxilla showed a significantly higher success rate than those placed in the mandible (Table III). The left side had significantly higher success than the right side.

For procedure management factors, the screw heads covered by overlying soft tissue showed higher success than the exposed screw heads in the oral mucosa, although it was not statistically significant. The screw implants in the UP showed higher success than those in other locations, although there was no statistical significance. There was no significant correlation in success rate according to the method of force application or placement angle. For environmental management factors, screw implants with inflammation showed significantly less success.

Some screw implants showed fracturing during placement and removal. A total of 8 screws were broken, 3 during placement and 5 during removal. Seven of the 8 fractured screws were type B, and the other was a type D miniscrew.

Screw implants with mobility and unknown samples showed significantly less success than those without mobility.

The odds ratios (relative risk) for screw implant failure with mobility and unknown were 0.041 and 0.167, respectively. The odds ratios of failure in the right side and in the mandible were 0.187 and 0.203, respectively (Table IV). Excluding the mobility variables in the logistic regression model, the odds ratios were 0.168 for screws on the right side, 0.187 for screws in the mandible, and 0.208 for implants with inflammation around them (Table V).

## DISCUSSION

Screw implants can fail for various reasons, as was found with dental implants.[10] The causes of dental implant failure include host factors (osteoporosis and

**Table II.** Means and standard deviations of clinical variables in success and failure groups

| Clinical variable | Success (n = 208) Mean | SD | Failure (n = 19) Mean | SD | Significance (Student t test) |
|---|---|---|---|---|---|
| Length of screw (mm) | 7.06 | 1.74 | 6.58 | 2.09 | .257 |
| Age (y) | 19.7 | 7.31 | 17.59 | 6.66 | .227 |
| Onset of force (wk) | 3.93 | 2.84 | 4.16 | 3.53 | .741 |
| Duration of force (mo) | 15.08 | 6.16 | 3.40 | 4.08 | .00 |

uncontrolled diabetes, smoking, and parafunctional habits), surgical factors of improper surgical technique, and management factors. Among these factors, smoking and other host factors were not evaluated in this study because the sample comprised children and young adults. The effects of these factors on failure of screw implants, however, should be elucidated in a future study.

Surgical factors include improper surgical techniques such as lack of initial stability, overheating during placement, and the fitness of the pilot hole to the diameter of the screw implant. In this study, because all screw implants were placed by same doctor with the same procedure, the effect of the surgical factors on the clinical success of the screw implants was not evaluated. However, by following this surgical procedure, clinicians might have acceptable success in practice.

Management factors include poor home care, inflammation or infection, oral hygiene, and excessive load. An earlier study found that 6 of 12 failed screw implants failed within 2 months after placement.[11] The reasons for failure might be errors during the surgical procedure. The remaining 6 screw implants failed between 2 and 10 months, and the cause might be management error. This might indicate that surgical and management procedures are both important for screw implant success.

Because this study is a new field, we know little about factors that affect the rates of success of screw implants. Therefore, in this study, we wanted to include as many factors as possible. Screw implant factors, host factors including local host factors at recipient sites, and procedure and environmental management factors were evaluated. Among them, significant differences were found in local host and management factors.

The factors associated with the failure of screw implants were mobility, side, and jaw of placement. Screw implants on the right side of the jaw had a higher failure rate, and the mandible had a higher failure rate

**Table III.** Success rate and number of screw implants according to clinical variables

| Clinical variable | Success rate (%) | Success/total screw implants (n) | Significance (chi-square or Fisher exact) |
|---|---|---|---|
| Diameter of screw | | | .357 |
| 1.2 mm | 91.9 | 204/222 | |
| 2.0 mm | 80 | 4/5 | |
| Sex | | | .21 |
| Male | 88.76 | 79/89 | |
| Female | 93.48 | 129/138 | |
| Jaw of placement | | | .01 |
| Maxilla | 96.0 | 119/124 | |
| Mandible | 86.4 | 89/103 | |
| Side of placement | | | .03 |
| Right | 86.3 | 101/117 | |
| Left | 97.3 | 107/110 | |
| Site of placement | | | .059 |
| LR and LD7 | 81.8 | 27/33 | |
| L67 | 90.5 | 57/63 | |
| A | 81.8 | 9/11 | |
| U56 and U67 | 95.4 | 103/108 | |
| UP | 100 | 12/12 | |
| Occlusogingival position | | | .45 |
| Lower oral mucosa | 88.4 | 76/86 | |
| Upper attached gingiva | 91.2 | 31/34 | |
| Upper oral mucosa-low | 91.5 | 65/71 | |
| Upper oral mucosa-high | 100 | 23/23 | |
| Angle of placement | | | .95 |
| 10°-20° | 91.0 | 61/67 | |
| 30°-40° | 95.2 | 100/105 | |
| 90° | 85.2 | 46/54 | |
| Method of force application | | | .26 |
| Power chain | 83.3 | 5/6 | |
| Super thread | 88.8 | 95/107 | |
| Nickel-titanium coil spring | 94.6 | 106/112 | |
| Ligature tie-back | 100 | 2/2 | |
| Ligature extension | | | .77 |
| Yes | 93.8 | 45/48 | |
| No | 91.1 | 163/179 | |
| Exposure of screw head | | | .06 |
| Closed | 94.6 | 123/130 | |
| Open | 87.6 | 85/97 | |
| Oral hygiene | | | .40 |
| Good | 100 | 18/18 | |
| Fair | 91.2 | 125/137 | |
| Poor | 90.3 | 65/72 | |
| Inflammation | | | .05 |
| Yes | 84.4 | 65/77 | |
| No | 95.3 | 143/150 | |
| Mobility | | | .00 |
| Yes | 75.6 | 34/45 | |
| No | 98.6 | 137/139 | |
| Unknown | 86.0 | 37/43 | |

Statistics: Chi-square or Fisher exact test.

**Table IV.** Odds ratios for failure of 227 screw implants including mobility

| Clinical variable | Log odds | | Odds ratio | P value | 95% CI |
|---|---|---|---|---|---|
| | Estimate | SE | | | |
| Mobility of screws (mobile) | −3.203 | 0.830 | 0.041 | .000 | 0.008-0.207 |
| Mobility of screws (unknown) | −1.792 | 0.873 | 0.167 | .040 | 0.030-0.922 |
| Side of placement (right) | −1.678 | 0.681 | 0.187 | .014 | 0.049-0.709 |
| Jaw of placement (mandible) | −1.596 | 0.681 | 0.203 | .019 | 0.053-0.769 |

**Table V.** Odds ratios for failure of 227 screw implants excluding mobility

| Clinical variable | Log odds | | Odds ratio | P value | 95% CI |
|---|---|---|---|---|---|
| | Estimate | SE | | | |
| Side of placement (right) | −1.783 | 0.666 | 0.168 | .007 | 0.046-0.619 |
| Jaw of placement (mandible) | −1.675 | 0.581 | 0.187 | .004 | 0.060-0.584 |
| Inflammation | −1.572 | 0.540 | 0.208 | .004 | 0.072-0.598 |

than the maxilla. Excluding mobility, inflammation around the screw implants was added as a relative risk factor.

In dental implants, mobility due to lack of osseointegration is a sign of failure.[10] For screw implants used as orthodontic anchorage, however, mobility might not represent failure. We checked the mobility of the screw implants 5 to 8 months after placement, during loading. Even though minimal mobility was a risk factor of failure, 34 of 45 minimally mobile screw implants were successful. By using comparatively low force (less than 200 g), the screw implants that showed minimal mobility could be set as anchorage. If heavy force is applied to screw implants, their mobility might be increased, and they can fail by not becoming sufficiently osseointegrated to the bone. In the animal studies of Ohmae et al[12] and Deguchi et al,[13] stable screw implants showed osseointegration from 25% to 40%. Deguchi et al[13] postulated that less osseointegration does not necessarily indicate a negative finding. When an excessive load is applied, partly osseointegrated screw implants can become severely mobile and eventually fail. Screw implants, however, can be maintained with minimal mobility when applied force is light. Dental implants are usually loaded in all directions in addition to vertical occlusal forces, but orthodontic screw implants are usually loaded with unidirectional lateral forces. Therefore, minimal mobility can be allowed in orthodontic screw implants. A study showing the reintegration of titanium implants after mechanical loosening[14] and the speculation of the possible success of implants with rotational mobility without bacterial infection after delayed loading[15] might support this. The nature of screw-implant removal after treatment can expand the boundaries of success to screw implants showing minimally discernible mobility.

The left side had higher success than the right. This might be explained by better hygiene on the left side of the dental arch by right-handed patients, who are most of the population.[16] Better hygiene could reduce inflammation around the screw implants.

The mandible was expected to have a higher success rate because it has a thicker and more dense cortical bone than the maxilla.[17,18] The results, however, were the opposite of our expectations. The assumed reasons might be overheating of the bone during drilling and irritation during chewing. Because the mandible has denser bone, there is a greater chance of generating heat greater than 47°C, which is the critical temperature that can cause bone damage.[19,20] In addition, screw implants placed in the posterior part of the mandible can easily be irritated by food during chewing. These factors might negatively affect the clinical success of screw implants. The reduced success of the screw implants in the LR and LD7 group might support this assumption. The mandibular posterior area was also considered a risk site in a study by Cheng et al.[9] To reduce heat generation, copious irrigation with saline solution was recommended.[21] Excessive pressure of the drill on the bone surface increased heat. Worn drills also produced more heat.[21]

As discussed in many previous studies of dental implants, peri-implantitis is an important factor in dental-implant failure.[22] Our results are similar to previous studies. Inflammation can damage the bone surrounding the neck of screw implants. With progressive damage of the cortical bone, screw implants can be endangered.[22,23] To ensure success, it is important to prevent inflammation around the screw implants. In this study, oral hygiene did not affect success, but local inflammation around the screw implants did. Local inflammation can be exaggerated not only by oral hygiene but also by weak nonkeratinized soft tissue around the neck of the screw implant. A recent study showed that nonkeratinized mucosa was a risk factor for miniscrews.[9] The highest success rate (100%) of screw implants placed in the maxillary palatal area where there is thick keratinized mucosa might support this. In addition, the screw implants in closed group, in which the head of screw was covered by soft tissue, had greater success than the open group, although it was not statistically significant. The overlying soft tissue on the head of screw implants might be a barrier against inflammation. We instructed patients to clean the screw implants with compressed water spray. Once inflammation arose, it tended to persist in nonkeratinized mucosa areas. Francetti et al[24] compared the effects of chlorhexidine spray and mouthwash on controlling plaque after implant surgery. They found that the plaque index improved, but there was no difference between the 2 methods. Therefore, water spray on screw implants might be an effective method to control inflammation.

There was no significant difference in the success rate with respect to the onset of force application. This might indicate that immediate loading of screw implants is possible. An animal experiment proved that there was osseointegration after immediate loading of the screw implants and suggested immediate loading to reduce the treatment time.[25] Recent reports also recommended immediate loading of screw implants.[6] Therefore, screw implants can be loaded immediately after placement without a discernible deterioration of stability.

There was no significant difference in the failure rates between the 3 placement angles of the screw implants. The reason for placing the screw implants at angles to the bone surface was to allow for use of long screw implants without damaging roots. The contact surface of the screw implants to the cortical bone was increased by placing them at angles. A study to elucidate the effects of the screw angle on the stability of the mandibular sagittal split osseotomy showed no difference in resistance to segment movement between the 60° and 90° angle groups.[26] Therefore, clinicians can place long screw implants with angulations to bone surface without decreasing stability, and the capability of using long screws might influence success positively. The length of dental implants was reported to have a positive effect on stability.[27] In our study, however, the length of the screw implants did not significantly affect their clinical success. Also, their diameter did not affect success rates, in contrast to another study.[8] This was caused by a small sample using 2.0-mm diameter screws.

This study was performed to screen every possible factor that could affect the success of screw implants. The sample was collected consecutively in 1 clinic, so the study design might not have been appropriate to assess the effect of screw diameter, length, and type on success. The other problem in this study was a small failure rate. This small number of failures (19 of 227) seemed to be insufficient to evaluate the effect of each factor with statistical significance.

As mentioned earlier, the success rate for screw implants in previous studies varied between 83.9% and 93.3%.[8,9,11] These rates might be explained by the various types of screw implants, different surgical techniques, and varying management protocols. Therefore, a direct comparison of success rates might not be possible. An important aspect, however, is that by removing every possible cause of failure that was discussed in each study, clinicians might be able to increase the chances of success.

In this study, the overall success rate of screw implants used as anchorage was 91.6% with a mean time of 15 months of force application. Including the replaced the screw implants, the success rate would be almost 96.5%. In a study by Miyawaki et al,[8] all 1.0-mm diameter screws failed, but the 1.5-mm and 2.3-mm diameter screws showed no significant difference with success rates of 83.9% and 85%, respectively. Our results, in conjunction with the study by Miyawaki et al,[8] indicate that screws with diameters of 1.2, 1.5, and 2.3 mm have acceptable levels of success. The 1.0-mm diameter screw, however, had too much failure clinically even though animal studies showed osseointegration.[12,13] From a clinical point of view, smaller diameter screws are easier and less traumatic to place and use. Screw implants with a diameter over 1.2 mm can be recommended as orthodontic anchor screw implants.

The mean period of force application to the miniscrew or microscrew implants was 15 months, which is sufficient to provide proper anchorage in most orthodontic patients. The most critical time period demanding anchorage control for successful orthodontic treatment is for anterior tooth retraction in extraction patients. This usually takes 10 to 12 months of microscrew implant anchorage sliding mechanics.[6] In nonextraction treatment, the distal movement of the posterior segment can be obtained within 10 months. This is because the posterior segment can be distalized together, and not 1 tooth at a time.[7] Therefore, microscrew implants seem to cover the critical time period requiring absolute anchorage.

Five screw implants were fractured during the removal procedure. If there is too much osseointegration, clinicians might have difficulty in removing the screws, or they can fracture. There has been no study of how much osseointegration is needed for orthodontic screw implants when considering the need for both stability and easy removal. This should be elucidated in a well-designed experimental model.

## CONCLUSIONS

The overall success rate was 91.6%, with a mean period of force application of 15 months. Therefore, screw implants can be used for orthodontic anchorage predictably and consistently in routine orthodontic practice. Mobility, the patient's right side, mandibular implant sites, and inflammation were associated with screw implant failure in this study. To minimize failure, clinicians should attempt to reduce inflammation around the screw implants, especially for screws placed on the right side in the mandible.

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