

FACTORS AFFECTING THE EFFECT OF MICROIMPLANT TREATMENT FOR ORTHODONTIC PATIENTS

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ABSTRACT

Objective: To investigate the associated factors affecting the therapeutic effect of microimplants for orthodontic patients.

Methods: The clinical data of 175 (280 cases) malocclusion patients treated with microimplants from August 2019 to August 2021 were retrospectively collected. These patients were classified into unsuccessful groups (31 cases) and successful groups (249 cases) based on their microimplant loosening failure information. Then, the clinical data from the successful and unsuccessful groups were statistically analyzed, and factors associated with multivariate Logistic regression analysis were used to influence the effect of microimplant treatment for the orthodontic patients.

Results: The proportions of patients aged no more than 12 years, with vertical bone plane type and high angle, poor oral hygiene, and mandible implanted with dental arch account for 35.48%, 54.84%, 67.74% and 64.52%, respectively. The proportions were higher than 14.46%, 28.92%, 25.70%, and 28.92% of the successful group ($P < 0.05$). The results of multivariate Logistic regression analysis showed that the age (≤ 12 years), vertical bone plane type and high angle, poor oral hygiene, and mandible implanted with dental arch are the independent risk factors affecting the effect of microimplant treatment of orthodontic patients ($OR = 1.145, 3.232, 6.290, 5.663, P < 0.05$).

Conclusion: The risk factors affecting the effect of microimplant treatment in orthodontic patients are the age (≤ 12 years), vertical bone plane type and high angle, poor oral hygiene, mandible implanted with dental arch, etc. According to the above factors, orthodontic patients undergoing microimplant treatment can be subjected to targeted treatment and intervention, so as to further improve the success rate of the micro implant treatment.

Keywords: Orthodontic, microimplants, treatment effect, related factors, oral hygiene, vertical bone surface type, mandible.

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Introduction

Malocclusion deformity can lead to the dislocation of teeth, dental arch stenosis, abnormal tooth arrangement, occlusal surface, facies cranii, and other symptoms⁽¹⁾. Therefore, timely orthodontic treatments are of vital importance for preventing malocclusion deformity. Many factors such as heredities, dental disorders, bad oral habits can lead to malocclusion deformity in the body. Skeletal

anchorage is a common method for the treatment of malocclusion deformity, including micro titanium plate, microimplant, enzymatic ligation, etc. Among the methods, microimplant is widely used in clinical treatment due to its advantages of small volume, small foreign body sensation, simple surgical operation and low cost after implantation.

However, microimplant may become loose, resulting in the treatment failure with increased treatment costs and patient suffering^(2, 3). According

to Liu Su et al.⁽⁴⁾, the risk factors for loosed microimplant can be attributed to the age, oral health, stress time, etc., but some clinicians' attention factors such as implantation site and implantation angle were not fully investigated.

In this context, this work presented a thorough analysis of the risk factors affecting the effect of microimplant treatment for orthodontic patients, and reported the results as follows.

Data and methods

Clinical data

The clinical data of 175 (280 cases) malocclusion patients treated with microimplants from August 2019 to August 2021 were retrospectively collected. These patients with malocclusion deformity were divided into unsuccessful (31 cases) and successful (249 cases) groups based on whether the micro implant failed or not. Specific clinical data of the two groups are shown in Table 1.

Inclusion criteria:

- The diagnostic criteria for malocclusion deformity meet the relevant diagnostic criteria in the Modern Clinical Orthodontics⁽⁵⁾;
- Microimplant treatment patients in our hospital;
- The patients with complete clinical data in the medical record system of our hospital.

Exclusion criteria:

- Patients with a previous history of permanent tooth extraction, orthogandibular, and orthodontic treatment;
- Patients with diabetes, hyperparathyroidism, cushing's syndrome and other diseases that can affect bone metabolism;
- Risk-prone patients with combined immune system diseases.

The study trial design was approved by the medical ethics committee of our hospital.

Method and observation index

Clinical data analysis

Clinical data were collected on the age, sex, vector bone surface type, vertical bone surface type, oral health, implanted dental arch, area, implanting method, implanting angle, and load timing of patients in the unsuccessful and successful groups.

Vector bone surface type

The angle of the Frankfurt plane with the

mandibular plane is classified into Low Angle (<22°), Equal Angle (22°~32°), and High Angle (>32°).

Vertical bone surface type

The an angle between the root upper socket and the root and lower socket is classified into level I (2°~4°), level II (>4°), and level III (<2°); oral health is grade into Good (<25), moderate (25~50), and Poor (>50) using the orthodontic plaque index⁽⁶⁾.

Analysis of risk factors affecting the effect of orthodontic patients microimplant treatment

Statistically significant factors different in the results of clinical data analysis were included in the multivariate analysis and Logistic regression was used to analyze the multivariate risk factors affecting orthodontic patients microimplant treatment effect.

Statistical methods

Data analysis was performed using the SPSS 21.0 software. Counting data are indicated by [n (%)], with χ^2 comparing tests and χ^2 trend tests between multiple groups.

Risk factors affecting the treatment efficacy of orthodontic patients microimplant were analyzed by multivariate Logistic regression analysis. $P < 0.05$ represents a statistically significant difference.

Result

Analysis of the clinical data in the two groups

In the unsuccessful group, the patients with age less than 12, vertical bone surface type as High Angle, oral health as Poor, implanted dental arch asmandibula account for 35.48%, 54.84%, 67.74%, 64.52%, which are all higher than that of unsuccessful group (14.46%, 28.92%, 25.70%, 28.92%) ($P < 0.05$). However, the gender, vector bone surface type, region, implanting method, implanting angle and load timing showed no statistically significance ($P > 0.05$), as shown in Table 1.

Analysis of risk factors affecting the effect of orthodontic patients microimplant treatment

The results of the multivariate Logistic regression analysis showed that age less than 12 years old, vertical bone surface type with High Angle, oral health with Poor condition, and implanted dental arch as jawbone were independent risk factors affecting the effect of orthodontic patients microimplant treatment (OR=1.145, 3.232, 6.290, 5.663, $P < 0.05$), as shown in Table 2.

Factor	Unsuccessful group (31 cases)	Successful group (249 cases)	χ^2	P
Age (year)	-	-	42.847	<0.001
<12	11 (35.48)	36 (14.46)	-	-
12~18	14 (45.16)	125 (50.20)	-	-
>18	6 (19.35)	88 (35.34)	-	-
Gender	-	-	0.110	0.740
Male	11 (35.48)	96 (38.55)	-	-
Female	20 (64.52)	153 (61.45)	-	-
Vertical bone surface type	-	-	0.349	0.527
I	9 (29.03)	69 (27.71)	-	-
II	18 (58.06)	153 (61.45)	-	-
III	4 (12.90)	27 (10.84)	-	-
Vertical bone surface type	-	-	10.748	<0.001
Low Angle	2 (6.45)	45 (18.07)	-	-
Equal Angle	12 (38.71)	132 (53.01)	-	-
High Angle	17 (54.84)	72 (28.92)	-	-
oral health	-	-	22.636	<0.001
Good	1 (3.23)	38 (15.26)	-	-
Moderate	9 (29.03)	147 (59.04)	-	-
Poor	21 (67.74)	64 (25.70)	-	-
Implanted dental arch	-	-	15.837	<0.001
Exognathion	11 (35.48)	177 (71.08)	-	-
Jawbone	20 (64.52)	72 (28.92)	-	-
Area	-	-	0.025	0.874
Lip cheek side	26 (83.87)	206 (82.73)	-	-
Palatal side	5 (16.13)	43 (17.27)	-	-
Implanting method	-	-	3.370	0.066
Holding attack	20 (64.52)	197 (79.12)	-	-
Self attack	11 (35.48)	52 (20.88)	-	-
Implanting angle (°)	-	-	0.204	0.493
10~20	3 (9.68)	26 (10.44)	-	-
30~45	20 (64.52)	150 (60.24)	-	-
60~70	4 (12.90)	47 (18.88)	-	-
90	4 (12.90)	26 (10.44)	-	-
Load timing (month)	-	-	0.735	0.927
0	4 (12.90)	25 (10.04)	-	-
1	21 (67.74)	154 (61.85)	-	-
2	4 (12.90)	55 (22.09)	-	-
3	2 (6.45)	15 (6.02)	-	-

Table 1: Analysis of the clinical data of the two groups [n (%)].

Variables	B	SE	Wald/ χ^2	P	OR	95%CI
Age less than 12 years old	0.135	0.057	5.609	0.018	1.145	1.024~1.280
Vertical bone surface type with High Angle	1.173	0.343	11.695	0.001	3.232	1.650~6.330
Oral health with Poor condition	1.839	0.663	7.694	0.006	6.290	1.715~23.069
Implanted dental arch with jawbone	1.734	0.328	27.948	<0.001	5.663	2.978~10.771

Table 2: Analysis of the risk factors affecting the effect of orthodontic patients microimplant treatment.

Discussion

Micro implant is a common orthodontic method for the clinical treatment of malocclusion deformity, but microimplant has a certain risk of losing, which will lead to higher treatment cost and worse recovery⁽⁷⁾. Therefore, it is important to analyze the independent risk factors affecting the treatment effect of orthodontic patients microimplant, and then take the corresponding treatment measures to improve the clinical efficacy. However, the published studies on the factor of microimplant treatment effect failed to reach a consistent conclusion. In this context, this study analyzed the influencing factors of orthodontic patients microimplant treatment effect.

The results of this study show that, in the unsuccessful group, the age less than 12 years, vertical bone surface type with the High Angle, oral health with the Poor condition, and implanted dental arch with jawbone are higher than that of the successful group. It suggests that the orthodontic patients microimplant treatment effect can be related to patient with the age less than 12 years, vertical bone surface type with the High Angle, oral health with the Poor condition, and implanted dental arch with jawbone. This is consistent with the findings of Manan⁽⁸⁾, Wu Yeke et al.⁽⁹⁾.

In addition, the results of this study also showed that the age less than 12 years, vertical bone surface type with the High Angle, oral health with the Poor condition, and implanted dental arch with jawbone are independent risk factors affecting the effect of orthodontic patients microimplant treatment. The reason may be that orthodontic patients bone tissue younger than 12 years is in active stage with insufficient bone thickness and no mature calcified bone, and bone resorption is less than bone deposition speed, resulting in lower microimplant stability than that of patients over 12 years of age, thus leading to the poor treatment effect of microimplant^(10, 11). Therefore, the rational use of medicine is needed

to regulate the speed of orthodontic patients bone absorption younger than 12 years old to improve the success rate of microimplant treatment. Orthodontic patients under vertical bone surface type with High Angle are normally in cortical bone thickness and bone density is low, leading to the micro implant prone to loose and decreasing the treatment effect⁽¹²⁾. Therefore, vertical bone surface type with High Angel should be instructed to come to the hospital on time for examination and maintain microimplant regularly. The food residues will accumulate around microimplant, multiply harmful microorganisms in the mouth, and then promote the body inflammation and invade microimplant surrounding alveolar bone, bone erosion, and then lead to microimplant loosening and decrease the treatment effect^(13, 14).

At the same time, the inflammatory response due to poor oral health can also cause the swelling of the tissue surrounding the micro implant, destroy the micro implant neck bone tissue, and reduce the micro implant stability. Therefore, it is necessary to increase the importance of orthodontic patients to oral health and develop the good oral health habit. Jawbone orthodontic patients should theoretically have a higher success rate due to large jawbone density, bone thickness and high early stability, etc. However, the success rate is actually found to be lower than that of exognathion, probably because exognathion needs to be prepared with pioneer drill when microimplant is implanted, which may lead to bone damage, and then affect the treatment effect⁽¹⁵⁾. At the same time, compared with exognathion, jawbone blood flow and nutrients supply are relatively poor, resulting in a prolonged binding time of microimplant and bone, leading to poor stability in the later stage and worse treatment effect⁽¹⁶⁾. In addition, because the jawbone is under great pressure when chewing, and the difficulty of cleaning after eating, the stability of microimplant is also relatively poor, and a large number of bacteria around the implant are easy to cause infection, so it will affect the therapeutic effect of microimplant⁽¹⁷⁾. Therefore, attention should be paid to the balanced diet of orthodontic patients. At the same time, patients should be asked to avoid excessive oral use which could result in microimplant loosening.

Overall, the risk factors affecting the effect of orthodontic patients microimplant treatment are the age less than 12 years, vertical bone surface type with the High Angle, oral health with the Poor condition, and implanted dental arch with jawbone. Thus, orthodontic and patients can be treated and

intervened according to the above factors to improve the success rate of microimplant treatment. This study analyzed the concerned factors of clinicians and can further provide reference for clinical treatment, but the number of cases selected in this study is small, and there is a certain locality.

Meanwhile, the study takes into account of the impact of different brands of microimplant on the study, so the study sample size can be expanded and the scope of case selection for further study. At present, the application of micro implant is still constantly developing, and it is believed that the clinical application of microimplant will be further promoted in the future.

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