

Clinical Report

CLINICAL EVALUATION OF OSSEOINTEGRATED IMPLANTS IN TOKYO DENTAL COLLEGE HOSPITAL (THIRD REPORT): LONG TERM OBSERVATION OF FUNCTIONING SURVIVAL RATE OF FIXTURES

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Abstract

The objective of this report was to review 365 cases of Brånemark Implant Bridge including 1,444 fixtures in patients of Tokyo Dental College Chiba Hospital. The term of implantation was divided into several phases; less than 1 year, from 1 year to 3 years, from 3 years to 5 years, from 5 years to 7 years, from 7 years to 10 years, more than 10 years, and the survival rate was calculated for each phase. The removal rate of fixture after connecting the superstructure was 13% in maxillary cases and 2% in mandibular cases. The functioning survival rate in maxillary cases slightly decreased from 91% in less than 1 year to 87% after more than 10 years; however, the functioning survival rate in mandibular cases was about 99% in all periods. The removal rate of fixtures per patient was 23% in maxillary cases and 6% in mandibular ones. The average removal number of fixtures was 1.8 in maxillary cases and 1.2 in mandibular ones. The removal of the fixture occurred most frequently at less than 1 year in maxillary cases, but there was no tendency for a pattern of removal of fixture in mandibular cases.

Key words: Survival rate—Osseointegrated implant—Retrospective survey

INTRODUCTION

The osseointegrated implant bridge (OIB) developed by Professor Brånemark provides excellent results in the majority of cases^{1-3,7)}. OIB was introduced to the Tokyo Dental College Hospital in 1983. From 1983 to 2000,

1,444 fixtures were applied to maxillae and/or mandibles in about 365 patients. Although a few fixtures had to be removed, excellent progress was observed^{6,8)}. There are some reports on the survival rate of OIB fixtures, but only a few have considered the functioning survival rate, which considers their ability to

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Table 1 Total number of cases corresponding to each classification

Duration Kind	Less than 1 year	Between 1 and 3 years	Between 3 and 5 years	Between 5 and 7 years	Between 7 and 10 years	More than 10 years
Maxillary Edentulous	25	25	18	18	17	17
Maxillary Partially Edentulous	69	69	49	49	13	13
Mandibular Edentulous	98	98	87	87	87	87
Mandibular Partially Edentulous	173	173	138	138	53	53

continue to bear functional occlusal stress^{4,5)}. In this report, the functioning survival rate of fixture was discussed from the point of view of 17 years of clinical experience.

MATERIALS AND METHODS

The subjects of this report were 365 adult patients who had 1,444 fixtures installed in their maxillae and/or mandibles. The kind of OIB cases in these 365 cases were 25 maxillary edentulous, 69 maxillary partially edentulous, 98 mandibular edentulous, and 173 mandibular partially edentulous. The total numbers of cases in each classification are listed in Table 1. These 365 cases were classified into 6 groups on the basis of the clinical record of the duration of the time from when the fixture was connected to superstructure until its removal: less than 1 year, between 1 year and 3 years, between 3 years and 5 years, between 5 years and 7 years, between 7 years and 10 years, and more than 10 years. The decision to remove the superstructure and/or fixtures was based on loss of its osseointegration^{6,8)}.

RESULTS

1. Removal rate of OIB fixtures

In maxillary and/or mandibular, edentulous and/or partially OIB cases, there were some cases in which the fixture was removed after

the superstructure was connected. Because they had lost osseointegration, 43 of 365 fixtures in maxillary cases and 19 of 1,079 fixtures in mandibular cases were removed.

- 1) In the maxillary OIB cases, it was necessary to remove 14 of 158 fixtures in the edentulous cases and 20 of 207 fixtures in the partial edentulous cases in the period of less than 1 year, 1 of 148 fixtures in the edentulous cases in the period of between 1 and 3 years, and 5 of 100 fixtures in the edentulous cases and 2 of 141 cases in the partially edentulous cases in the period of between 3 and 5 years; however, only 1 of 49 fixtures was removed in edentulous cases after that (Table 2). Thus, the removal rate in maxillary OIB cases was 9.3% (34/365) in the period of less than 1 year, 0.3% (1/364) in the period of between 1 and 3 years, and 2.9% (7/241) in the period of between 3 and 5 years. After 7 years, it was exceedingly low.
- 2) In the mandibular OIB cases, it was necessary to remove 4 of 546 fixtures in the edentulous cases and 5 of 533 fixtures in the partially cases in the period of less than 1 year, 2 of 1,533 fixtures in the edentulous cases and 2 of 491 cases in the partially edentulous cases in the period of between 1 and 3 years, and 4 of 486 fixtures in the edentulous cases and 2 of 420 cases in the partially edentulous cases in the period of between 3 and 5 years; however, no fixture was removed in either group after that

Table 2 Removal rate of OIB fixture

Duration Kind	Less than 1 year	Between 1 and 3 years	Between 3 and 5 years	Between 5 and 7 years	Between 7 and 10 years	More than 10 years
Maxillary Edentulous	14/158	1/148	5/100	0/96	1/49	0/29
Maxillary Partially Edentulous	20/207	0/198	2/141	0/81	0/44	0/14
Mandibular Edentulous	4/546	2/533	4/486	0/448	0/372	0/228
Mandibular Partially Edentulous	5/533	2/491	2/420	0/300	0/174	0/59

Table 3 Functioning survival rate of OIB fixture in each period

Duration Kind	Less than 1 year	Between 1 and 3 years	Between 3 and 5 years	Between 5 and 7 years	Between 7 and 10 years	More than 10 years
Maxillary Edentulous	91.1%	99.3%	95.0%	0	97.9%	0
Maxillary Partially Edentulous	90.3%	0	98.6%	0	0	0
Mandibular Edentulous	99.3%	99.6%	99.2%	0	0	0
Mandibular Partially Edentulous	99.1%	99.6%	99.5%	0	0	0

(Table 2). Thus, the removal rate in mandibular OIB cases was 0.8% (9/1,079) in the period of less than 1 year, 0.4% (4/1,024) in the period of between 1 and 3 years, 0.6% (6/906) in the period of between 3 and 5 years. After that, the rate fell to zero.

2. Functioning survival rate of OIB fixtures

The removal rate in maxillary OIB cases in each period was 9.3% in less than 1 year, 0.3% in between 1 and 3 years, 2.9% in between 3 and 5 years, and almost 0% after more than 7 years. The functioning survival rate in each period is the inverse ratio of the removal rate of the fixtures in each period, as shown in Table 3. We defined the functioning survival rate of OIB fixtures as the ratio of the total number of fixtures connected to superstructures to those finally remaining. The function-

ing survival rate in each period in maxillary cases was 90.7% at less than 1 year, 99.7% between 1 and 3 years, and 98.1% between 3 and 5 years. Cumulatively, the functioning survival rate in maxillary cases was 90.7% at less than 1 year, 90.4% (0.907×0.997) between 1 and 3 years, 88.7% (0.981×0.904) in between 3 and 5 years, and it remained at almost 87% after more than 10 years. Similarly, the functioning survival rate in mandibular cases was 99.2% at less than 1 year, 98.8% (0.996×0.992) between 1 and 3 years, 98.2% (0.994×0.988) in between 3 and 5 years, and it remained at 98.2% after more than 10 years.

It was defined the functioning survival rate of OIB fixtures within each period as the ratio of the number of functioning fixtures at the beginning to those at the close of an observation period. The functioning survival rate of

Table 4 Functioning survival rate of OIB fixture

Duration Kind	Less than 1 year	Between 1 and 3 years	Between 3 and 5 years	Between 5 and 7 years	Between 7 and 10 years	More than 10 years
Maxillary Edentulous	91.2%	90.6%	86.0%	86.0%	84.3%	84.3%
Maxillary Partially Edentulous	90.3%	90.3%	89.0%	89.0%	89.0%	89.0%
Mandibular Edentulous	99.3%	98.9%	98.1%	98.1%	98.1%	98.1%
Mandibular Partially Edentulous	99.1%	98.7%	98.2%	98.2%	98.2%	98.2%

the OIB fixtures in the maxillary edentulous cases was 91.2% at less than 1 year, 90.6% between 1 and 3 years, 86.0% in between 3 and 7 years, and 84.3% after more than 7 years. In the maxillary partially edentulous, it was 90.3% at less than 1 year, 90.3% between 1 and 3 years, and 89.0% at more than 3 years (Table 4). The functioning survival rate of the OIB fixtures in the mandibular edentulous cases was 99.3% at less than 1 year, 98.9% between 1 and 3 years, and 98.1% at more than 3 years. In the mandibular partially edentulous cases, it was 99.1% at less than 1 year, 98.7% between 1 and 3 years, and 98.2% at more than 3 years (Table 4).

3. Frequency of cases with fixture removal

1) In the maxillary edentulous OIB cases, it was necessary to remove 7 fixtures from 25 patients within less than 1 year, 1 fixture of 25 patients in between 1 and 3 years, and 1 fixture of 18 patients in between 3 and 5 years; only 1 fixture of 17 patients was removed in between 7 and 10 years (Table 5). Thus, the frequency of removal per patient was 28.0% in less than 1 year, 4.0% between 1 and 3 years, 5.6% between 3 and 5 years, and very low very after that.

In the maxillary partially edentulous OIB cases, it was necessary to remove 12 fixtures from 69 patients within less than 1 year, 0 fixtures from 69 patients in between 1 and 3 years, and 1 fixture from 49 patients in between 3 and 5 years, but no fixtures were

removed after that (Table 5). Thus, the frequency of removal per patient was 17.4% in less than 1 year, 0% in between 1 and 3 years, 2.0% in between 3 and 5 years, and 0% after that.

Thus, in all the maxillary OIB cases, the frequency of removal per patient was 20.2% in less than 1 year, 1.1% in between 1 and 3 years, 3.0% in between 3 and 5 years, and almost 0% after that.

2) In the mandibular edentulous OIB cases, it was necessary to remove 4 fixtures from 98 patients in less than 1 year, 2 fixtures from 98 patients in between 1 and 3 years, and 2 fixtures from 87 patients in between 3 and 5 years, but no fixtures were removed after more that (Table 5). Thus, the frequency of removal per patient was 4.1% in less than 1 year, 2.0% in between 1 and 3 years, 2.3% in between 3 and 5 years, and 0% after that.

In the mandibular partially edentulous OIB cases, it was necessary to remove 4 fixtures from 173 patients in less than 1 year, 2 fixtures from 173 patients in between 1 and 3 years, and 2 fixtures from 138 patients in between 3 and 5 years, but no fixtures were removed after that (Table 5). Thus, the frequency of removal per patient was 2.3% in less than 1 year, 1.2% in between 1 and 3 years, 1.4% in between 3 and 5 years, and 0% after that.

Thus, in all the mandibular OIB cases, the frequency of removal per patient was

Table 5 Frequency of cases who removed the fixture

Duration Kind	Less than 1 year	Between 1 and 3 years	Between 3 and 5 years	Between 5 and 7 years	Between 7 and 10 years	More than 10 years
Maxillary Edentulous	7/25	1/25	1/18	0/18	1/17	0/17
Maxillary Partially Edentulous	12/69	0/69	1/49	0/49	0/13	0/13
Mandibular Edentulous	4/98	2/98	2/87	0/87	0/87	0/87
Mandibular Partially Edentulous	4/173	2/173	2/138	0/138	0/53	0/53

Table 6 Numbers of fixture per patients who removed the fixture

Duration Kind	Less than 1 year	Between 1 and 3 years	Between 3 and 5 years	Between 5 and 7 years	Between 7 and 10 years	More than 10 years
Maxillary Edentulous	14/7	1/1	5/2	0/0	1/1	0/0
Maxillary Partially Edentulous	20/12	0/0	2/1	0/0	0/0	0/0
Mandibular Edentulous	4/4	2/2	4/2	0/0	0/0	0/0
Mandibular Partially Edentulous	5/4	2/2	2/2	0/0	0/0	0/0

3.0% in less than 1 year, 1.5% in between 1 and 3 years, 1.8% in between 3 and 5 years, and 0% in more than 5 years.

4. Number of fixtures removed per patient with fixture removal

- 1) In the maxillary edentulous OIB cases, it was necessary to remove 14 fixtures from 7 patients in less than 1 year, 1 fixture from 1 patient in between 1 and 3 years, and 5 fixtures from 2 patients in between 3 and 5 years; only 1 fixture from 1 patient was removed in 7 and 10 years after that (Table 6). Thus, the removal number of fixtures per patient was 2.0 in less than 1 year, 1.0 in between 1 and 3 years, 2.5 in between 3 and 5 years. In the maxillary partially edentulous OIB cases, it was necessary to remove 20 fixtures from 12 patients in less than 1

year, 0 in between 1 and 3 years, and 2 fixtures from 1 patient in between 3 and 5 years; no fixtures were removed after that (Table 6). Thus, the removal number of fixtures per patient was 1.7 in less than 1 year, 0 in between 1 and 3 years, 0.5 in between 3 and 5 years, and 0 after that. Then, in all the maxillary OIB cases, the removal number of fixtures per patient was 1.8 in less than 1 year, 1.0 in between 1 and 3 years, and 2.3 in between 3 and 5 years.

- 2) In the mandibular edentulous OIB cases, it was necessary to remove 4 fixtures from 4 patients in less than 1 year, 2 fixtures from 2 patients in between 1 and 3 years, and 4 fixtures from 2 patients in between 3 and 5 years; no fixtures were removed in 7 and 10 years after that (Table 6). Thus, the removal number of fixtures per patient was 1.0 in

less than 1 year, 1.0 in between 1 and 3 years, and 2.0 in between 3 and 5 years. In the maxillary partially edentulous OIB cases, it was necessary to remove 5 fixtures from 4 patients in less than 1 year, 2 fixtures from 2 patients in between 1 and 3 years, and 2 fixtures from 2 patients in between 3 and 5 years; no fixtures were removed after that (Table 6). Thus, the removal number of fixtures per patient was 1.3 in less than 1 year, 1.0 in between 1 and 3 years, 1.0 in between 3 and 5 years, and 0 after that. Thus, in the mandibular OIB cases, the removal number of fixture per patient was 1.1 in less than 1 year, 1.0 in between 1 and 3 years, 1.5 in between 3 and 5 years.

DISCUSSION

1. Removal rate of OIB fixtures

The removal rate in maxillary cases in each period was 9.3% in less than 1 year, 0.3% in between 1 and 3 years, and 2.9% in between 3 and 5 years, so the removal rate was greatest in the first year. Therefore, it appears that fixture removal rate may be concentrated in the first year in maxillary cases.

In contrast, the removal rate in mandibular cases was 0.8% in the first year, 0.4% in between 1 and 3 years, 0.7% in between 3 and 5 years, so the removal rate was similar in each period. Therefore, it appears that the fixture removal rate may remain fairly constant in each period in mandibular cases.

The removal rate in all periods was 11.8% in maxillary cases and 1.8% in mandibular cases; these values were increased in maxillary cases and decreased in mandibular cases compared with those in our second report, which recorded 9.6% in maxillary cases and 3.1% in mandibular cases. However, the differences in the rates for both maxillary and mandibular cases were less than only 2%.

2. Functioning survival rate of OIB fixtures

The functioning survival rate in maxillary cases was 91% in less than 1 year, 90% in

between 1 and 3 years, 89% in between 3 and 5 years, and it then remained at almost 87% until more than 10 years. The rate was slightly decreased in the early period compared with our second report that showed 93% in less than 1 year, 92% in between 1 year and 3 years, 92% in between 3 and 5 years, 92% in between 5 years and 7 years, and 87% in more than 7 years. However, there were no differences between the two reports in later periods in maxillary cases.

The functioning survival rate in mandibular cases was 99% in less than 1 year, 99% in between 1 and 3 years, 98% in between 3 and 5 years, and it then remained at 98% until more than 10 years. This rate for all periods (98%) was slightly increased in mandibular cases, compared with that in our second report (97%).

3. Frequency of cases with fixture removal

In the maxillary OIB cases, the frequency of removal per patient was 20% in less than 1 year, 1% in between 1 and 3 years, 3% in between 3 and 5 years, and almost 0% after more than 5 years. Therefore, the frequency of fixture removal was 1 of 5 patients in less than 1 year in maxillary cases and very low thereafter.

In the mandibular OIB cases, the frequency of removal per patient was 3.0% in less than 1 year, 1.5% in between 1 and 3 years, 1.8% in between 3 and 5 years, and 0% in more than 5 years. Therefore the frequency of fixture removal per patient was 1 of 33 patients in less than 1 year in maxillary cases and very low thereafter.

Thus, the number in maxillary cases in the first year was 1.5 times that in mandibular cases.

4. Number of fixtures removed per patient with fixture removal

In the maxillary OIB cases, the number of fixture removals per patient was 1.8 in less than 1 year, 1.0 in between 1 and 3 years, and 2.3 in between 3 and 5 years. In the mandibular OIB cases, the number of fixture removals per patient was 1.1 in less than 1 year, 1.0 in

between 1 and 3 years, and 1.5 in between 3 and 5 years. Thus, the number in maxillary cases in the first year was 1.5 times that in mandibular cases.

CONCLUSION

The objective of this report was to examine the functioning survival rate of OIB fixtures. The subjects were 365 patients who had 1,444 fixtures of Brånemark Implant Bridge implanted in Tokyo Dental College Chiba Hospital. The term divided into several phases; less than 1 year, between 1 year and 3 years, between 3 years and 5 years, between 5 years and 7 years, between 7 years and 10 years, and more than 10 years. The functioning survival rate was calculated in each phase. The results were as follows.

1. The removal rate of fixtures after connecting the superstructure was 13% in maxillary cases and 2% in mandible cases. There was a 6 fold difference between maxillary cases and mandibular cases.
2. The functioning survival rate in maxillary cases slightly decreased from 91% in less than 1 year to 87% in more than 10 years. However, the functioning survival rate in mandibular cases was about 99% in all periods.
3. The fixture removal rate per patient was 23% in maxillary cases and 6% in mandibular cases. There was a 4 fold difference between maxillary cases and mandibular cases.
4. The average number of fixture removals per patient was 1.8 in maxillary cases and 1.2 in mandibular cases. There was a 1.5 fold difference between maxillary cases and mandibular cases.
5. The removal of fixture occurred most frequently at less than 1 year in maxillary cases, but there was no tendency for the removal of fixture at any particular time in mandibular cases.

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