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Review Article

Implant treatment in ultra-aged society



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KEYWORDS

Geriatric dentistry;
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Minimum invasion;
Implant Card

Summary Implant therapy is gaining presence as a prosthodontic treatment option. However, the graying of the population has led to an increase in the number of older adults requiring special consideration in implant treatment because of their systemic health problems. Additionally, with the growth of the elderly population in need of long-term care, a greater number of older adults who have received implant treatment are receiving long-term care, raising various issues that need to be addressed. In the present review article, we describe the significance of implant treatment in older adults, issues when performing implant treatment in geriatric patients, and measures to be taken when implant patients have lapsed into a state of requiring long-term care. In addition, in view of population aging, we propose an approach for applying implant treatment to older adults. This approach includes using an appropriate type of implant system depending on the remaining life expectancy and the patient's general condition, performing less invasive surgery, providing treatment using prosthetic appliances that are easy to manage and can be modified, and ensuring oral health management by providing an Implant Card to patients when the treatment is completed.

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1. Introduction

Implant therapy is gaining presence as a prosthodontic treatment option. Meanwhile, dramatic population aging is a global phenomenon, and Japan is at the forefront (Fig. 1) [1]. As a result, the number of older adults who have general health problems and require special consideration in implant treatment is increasing. Additionally, with the growth of the elderly population in need of long-term care, a greater number of older adults who have received implant treatment are receiving long-term care (though the details are unknown), raising issues that need to be addressed. Accordingly, in the present article, we review the status of population aging and the situation of dental implant placement in Japan and the world, and describe the significance of implant treatment in older adults, issues when performing implant treatment in geriatric patients, and measures to be taken when implant patients have lapsed into a state of requiring long-term care.

2. Dental implants in an era of population aging in Japan and the world

Only limited data are available both domestically and internationally regarding the proportion of implant patients in the elderly population. Overseas, there was a sharp increase in the proportion of implant patients aged over 70 from 2002 to 2014 (from 7.7% to 21.0%) [2–4]. In Japan, the *Survey of Dental Diseases* (2011) [5] showed that approximately 3% of older adults had dental implants (Fig. 2), 49% of whom were the elderly aged 65 years or over. The forthcoming results of the 2016 survey are likely to show a further increase in the proportion of this cohort of implant patients. The results of

the 2011 survey showed that, of the 1510 participants who were 65 years or over, 47 individuals (3%) had implants. However, the situation of older adults requiring long-term care is unknown.

In another survey of older adults in need of long-term care [6], 360 (3%) of 12,356 people were found to have implants. However, this survey was administered not directly to patients, but to dentists who were providing home-visit dental care at long-term care facilities.

While there have been various reports on troubles with implants, there is insufficient data on the situation with older adults, particularly those who require long-term care. The present authors and their colleagues are compiling the results of an investigation carried out by the Research Development Committee of the Japanese Society of Oral Implantology, which will soon be published.

Today, the number of natural teeth in older adults is increasing (Fig. 3) [5], resulting in a decrease in the proportion of patients needing prostheses to replace missing teeth (Fig. 4). However, because of the rise in the absolute number of older adults, the number of patients with partial removable dental prostheses has barely decreased (Fig. 6) [7], despite a decline in the number of patients with complete dentures (Fig. 5). In old-olds, conversely, the number of patients with partial removable dental prostheses has increased. In this cohort of older adults, treatment with dentures is more difficult owing to resorption of alveolar ridge, thinning of mucosa [8], diminished keratinization [9], decreased pressure-pain threshold [10], salivary hypofunction caused by use of medication [11], decreased tongue pressure [12], decreased finger dexterity, deterioration of general condition, etc. Such factors are likely to increase the number of difficult clinical cases, and so the number of cases treated with implants will also increase.

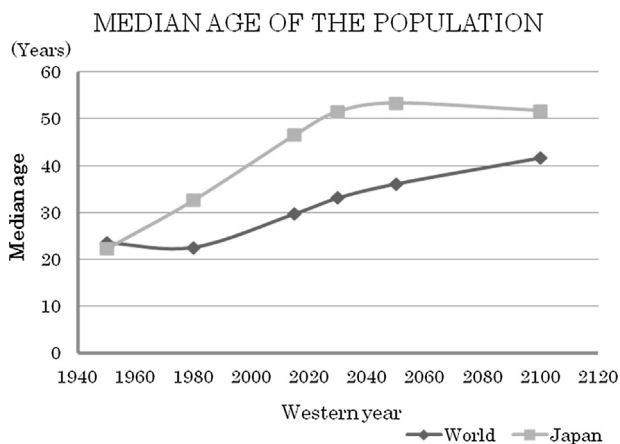


Figure 1 Japan and world aging (MEDIAN AGE OF THE POPULATION).

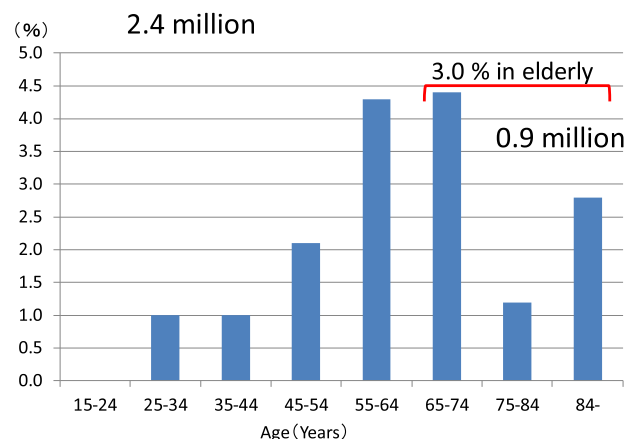


Figure 2 Proportion of people with implants.

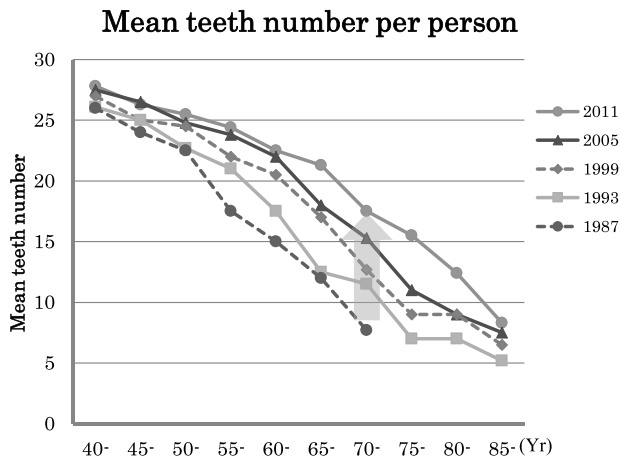


Figure 3 Mean teeth number per person. Yr, years old.

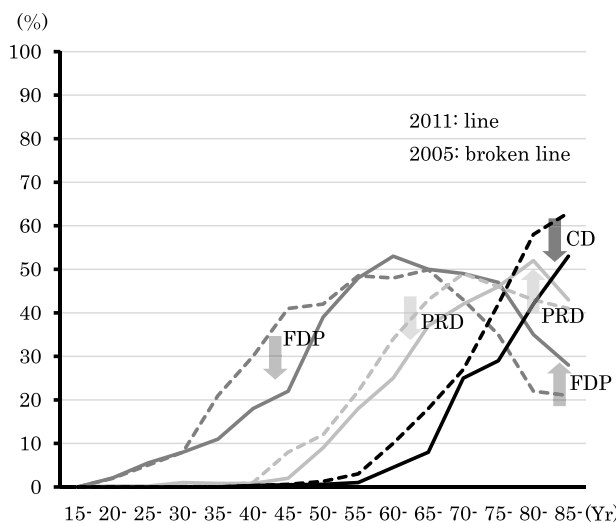


Figure 4 Proportion of persons with prostheses. CD, complete denture; FDP, fixed dental prosthesis; PRD, partial removable dental prosthesis; Yr, years old.

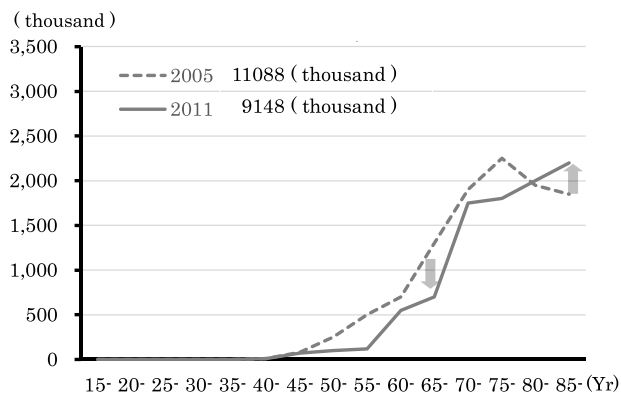


Figure 5 Number of CD patients. Yr, years old.

3. Effect of implants in older adults

Oral function deteriorates in older adults. The Japanese Society of Gerodontology prepared *Oral Hypofunction in the Elderly, The Position Paper from the Japanese Society of*

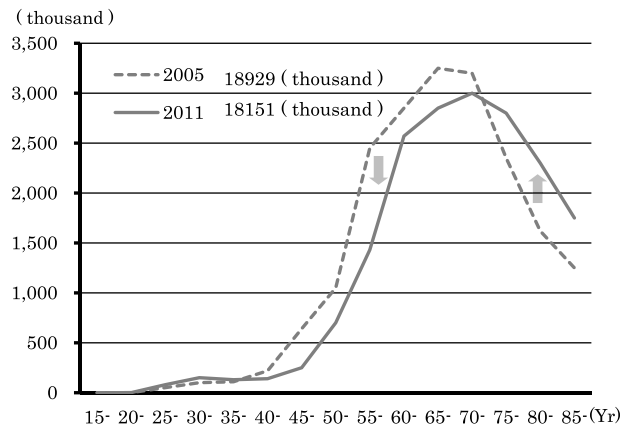


Figure 6 Number of PRD patients. Yr, years old.

Gerodontology in 2016 [13], which presented criteria for diagnosing deterioration of oral function. As the body of evidence is not yet sufficient, more data need to be accumulated in the future.

There have been many studies reporting a link between deteriorated oral function and systemic health conditions, levels of care needed, and lifespan. Regarding occlusion and masticatory function, in particular, many studies have been published [14–27]. Additionally, numerous studies have shown that dental implants bring a greater improvement in masticatory function than dentures [28–33]. Nevertheless, while a number of studies have reported improvement in quality of life (QOL) and satisfaction achieved by implants [28], these studies are ranked as a low level of evidence [29]. Moreover, most of the studies presented the effects of implant treatment on edentulous jaws [30]; very few reports ranked as a high level of evidence have been published on partially edentulous jaws [31].

It is common knowledge that, for edentulous mandible patients, overdentures retained by two implants are the first choice of care [32,33]. The treatment reduces bone atrophy, increases masticatory efficiency, reduces masseter atrophy, and significantly improves the oral hygiene status of the patient. However, implants used for overdenture of maxilla may be inferior in prognosis compared to that of mandible, and the research on the number of implants required for maxillary implant overdentures is not sufficient [32–34]. Moreover, in terms of what kind of attachments should be used, the most suitable ones, especially for patients requiring long-term care, are not yet known despite various proposals that have been made [35–37]. Further work on these issues is needed.

4. Points to note in implant treatment in geriatric patients

When performing implant treatment in geriatric patients, attention must be paid to the aspects described in Table 1 [4].

- Deterioration of general condition entails a risk when performing dental implant surgery. Conditions that require special attention include cardiovascular disease, diabetes mellitus, osteoporosis, cancer, rheumatic diseases,

Table 1 Points to note when performing implant treatment in geriatric patients.

- Deterioration of general condition
- Deterioration of periodontal condition
- Decline in oral cleansing management ability
- Decline in cognitive function
- Decreased oral function

and poor nutrition. These diseases and the effects of medicines used to treat them may affect implant surgery, wound healing, osteosynthesis, and long-term implant success. Therefore, it is crucial to evaluate the condition of patients and their adaptability to implant treatment. With regard also to implant surgery, surgical simulation using 3-D Cone Beam CT, flapless surgery, one-stage surgery, immediate placement/immediate loading, use of short and narrow diameter implants [38], etc. should be considered in order to plan minimally invasive surgery [4].

Additionally, careful judgment and adequate maintenance are required when xerostomia, Parkinson's disease, dementia, rheumatic diseases, etc. are involved because these conditions complicate postoperative maintenance.

- Deterioration of the periodontal condition is a challenge especially when the patient lapses into a state of requiring long-term care. Strategic tooth extraction may be considered based on the likely prognosis of the teeth. However, there is insufficient evidence on this issue.
- Considering the decline in the oral-care ability, cleanability needs to be taken into account, even if at the expense of aesthetics. Maintaining oral hygiene is given higher priority in implant treatment in older adults. Even though the patient may have good ability to manage oral cleansing at the time of designing a treatment plan, the decline in ability over time must also be considered.
- Decline in cognitive function in geriatric patients might hinder their full understanding of the explanation of the treatment plan, and so an appropriate evaluation of cognitive function is essential.
- Due to decreased oral function, replacing missing teeth simply with implants may not result in adequate recovery of masticatory function. A proper evaluation of decreased oral function as described above is needed, which is an area requiring further research.

From the above, there are four typical indications for implant treatment in older adults as compared to middle-to old-aged patients [4]; these indications have been established in view of the future decline in function.

- 1) When fixed dental prosthesis and partial removable dental prostheses are undesirable (cases where an adjacent tooth is sound and using it as an abutment for a fixed dental prosthesis is undesirable, or the patient's finger dexterity is inadequate and inserting/removing a denture is difficult) [39] (Fig. 7)
- 2) Cases where an abutment tooth for the existing denture has been lost (cases where the existing denture can be utilized with a slight modification by inserting an implant



Figure 7 Defect adjacent to a sound tooth. Implant prosthesis was performed on the maxillary right middle incisor tooth position without preparation for adjacent teeth.



Figure 8 Loss of an abutment tooth for the existing denture. Figure shows a partial removable dental prosthesis modified for the part of extracted abutment teeth.



Figure 9 Retaining a free-end denture with a distal implant is desirable.

to replace the abutment tooth; this allows the patient to become accustomed to the new status quickly and is also effective for preserving natural teeth) [40] (Fig. 8)

- 3) Cases where stabilization of free-end dentures with distal implants is desired [41–44] (Fig. 9)
- 4) Cases where stabilization of mandibular complete dentures is desired (overdentures retained by two implants) [33] (Fig. 10)



Figure 10 Mandibular two supported overdenture. Two attachments were incorporated in this removable denture.

5. Measures for implant patients upon reaching old age

It is conceivable that a number of implants will have been left osseointegrated for more than 20 years and are likely to remain in the patients' mouth after they reach a state of requiring long-term care until the end of their life [45]. Though once young and vigorous, patients inevitably get older and may face the challenges described in Table 1. The measures to be considered are as follows:

- Modification to designs that give priority to cleanability over aesthetics (such as widening interdental gaps to improve cleanability, etc.)
- Switching from a fixed prosthesis type to a removable prosthesis type (the back-off strategy [46]: improve cleanability and enhance adaptability to troubles/loss of implants)
- Removal/put the implants to sleep (to preclude damage to soft tissues and the counter jaw) (difficult to achieve with one-piece implants)
- Guidance to caregivers/improvement of their coping skills
- Contacts with dentists who provide home-visit dental care/request to offer dental care services

6. Implant treatment in consideration of aging of patients

Considering the above, when providing implant treatment to middle- to old-aged patients, it is important to consider their aging in future.

- Remaining life expectancy: It is necessary to gauge patients' remaining life expectancy taking their general condition into account. At present, the average remaining life expectancy + age in older adults is longer than the average lifespan (Table 2) [47]. Those who have lived to old age have outlived the average lifespan. Therefore, we should estimate how many more years on average the implants need to function considering the patients' general condition. Even though the average lifespan of women is 87.05, that does not mean that an 80-year-old

Table 2 Average remaining life expectancy + age by age stratum.

2015	Male	Female
Average lifespan	80.79	87.05
60 years	83.55	88.83
70 years	85.64	89.92
80 years	88.89	91.79
90 years	94.38	95.70

woman has only 7 more years to live; in fact, she is likely to live approximately another 12 years on average.

- Assuming that the patient is going to change dentist, it is necessary to pass on the details of the treatment to the next dentist. A survey on older adults requiring long-term care [6] showed that two-thirds of the implant patients surveyed had received the implant treatment from dentists other than those in charge of the home-visit dental care.

To assist the transfer of treatment information, it has been recommended that an Implant Card/Passport be issued [48] upon completion of implant treatment. However, over half of the dentists who were included in the above survey and were providing implant treatment were not using these tools [6]. The format of the tools for transferring treatment information should be standardized to gain wider use.

- Removable superstructures allow greater adaptability to changes in oral status at a later time. The changes can be managed by temporary cementation, but permanent cementation makes it difficult for clinicians to perform remedies afterward.
- Two-piece implants provide greater availability for various measures compared to one-piece implants. With two-piece implants, it is also possible to remove abutments and put the implants to sleep. Although cutting is possible for one-piece implants, it is very difficult to cut titanium alloy [49] during home-visit dental care.
- The system of the implant should be uniform in the mouth. Assuming that additional implants or re-fabrication of superstructures will be required in the future owing to loss of natural teeth, it would be convenient if the same implant system is used uniformly inside the mouth. In particular, when a patient changes dentist, it is more convenient if the patient can be treated with one implant system. Therefore, unless there are critical reasons, multiple systems should not be allowed to coexist. However, even if the same system is used, care is required because a major model change may occur.
- The preferred implant systems are those produced by manufacturers supplying the components on a long-term basis. Presently there are more than 30 companies that offer dental implant systems in Japan. It goes without saying that systems sold by manufacturers that will continue to supply the product for the next 10 or 20 years are more reliable. Although it is difficult to predict, there is a risk in using a system that has just been introduced by a new manufacturer. It is hoped that replacement parts and instruments will continue to be supplied in the future.

- Compatibility of instruments is also important. Currently, the standard for screws used to retain superstructures varies among manufacturers, with 10 or more types existing in Japan. Since the screwdrivers available depend on the type of screws, use of a screwdriver of a different standard may damage the screws. It requires effort to carry various instruments during home-visit dental care, and it is also difficult to identify the type of screws macroscopically. Although these problems could be resolved by standardization of screws, conflicts of interest among manufacturers make it difficult. Hence, it is important for scientific societies and the government to take leadership to expedite standardization.
- In Japan, implant treatment is paid in full by patients except for certain jaw defects. Management and repair of implants are also not covered by the national health insurance. However, many patients institutionalized in old age are in financial difficulties, and as a result, dentists providing home-visit dental care often carry out very intricate implant management on a voluntary basis. These issues will be highlighted in a large-scale survey currently being planned by the authors and colleagues to investigate the status of implant patients in home-visit dental care. It is hoped that scientific societies and the government will actively intervene to address these issues as well.

7. Conclusion

When providing implant treatment to older adults, their general condition and oral aging need to be considered. The typical indications for implant treatment in older adults are “intermediary defect adjacent to a sound tooth,” “loss of an abutment tooth for the existing denture,” “free-end dentures,” and “edentulous mandible.” When implant patients reach old age, “to improve cleanability,” “to change to removable superstructures,” “to put implants to sleep,” and “to form a collaborative alliance with the dentists/caregivers in charge” are crucial. In view of aging, “consideration of remaining life expectancy,” “prevalence of Implant Card,” “removable superstructures,” “use of two-piece implants,” “unification of implant system,” “continuity of manufacturers,” “compatibility of instruments,” and “examination of healthcare system” are important.

Conflict of interest statement

The authors have no conflict of interest to declare.

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