Comparison of Patient's Satisfaction with Implant-supported Mandibular Overdentures and Complete Dentures

Yu-Hwa Pan[1], Tai-Min Lin[1], Chao-Hua Liang[2]

Background: The purpose of this study was to compare patients' subjective experiences with respect to long-term satisfaction with mandibular implant-retained overdentures versus conventional complete dentures.

Methods: Among 85 completely edentulous patients, 60 were treated with four one-stage titanium implants and overdentures retained by a cast bar with extracoronal attachments. These patients constituted the experimental group, and were subsequently evaluated clinically over a period of up to 6 years. The other 25 patients constituted the control group and were treated with conventional complete dentures without implant retained. All the patients (n = 60) in the experimental group responded to questions on their experiences before and after treatment with the implant-retained overdentures. Sixty percent (n = 15) of the 25 patients in the control group responded to the questionnaire.

Results: No implants or restorations failed during the observation period. The experimental group, however, showed significant differences with the control group in terms of their responses to the questionnaire.

Conclusion: The use of implants to retain and support the overdenture improved comfort and gave the experimental patients greater self-confidence in social interactions, in addition to more effective oral rehabilitation. The results demonstrate that the effects of rehabilitation of the mandibular arch with an implant-retained overdenture are predictable.

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At a Glance Commentary

Scientific background of the subject

This study was to compare patients' subjective experiences with respect to long-term satisfaction with mandibular implant-retained overdentures versus conventional complete dentures.

What this study adds to the field

Ths use of implants to retain and support the overdenture improved comfort and gave the patients greater self-confidence in social interactions, in addition to more effective oral rehabilitation. This study demonstrates that the effects of rehabilitation of the mandibular arch with an implant-retained overdenture are predictable.

Key words: clinical satisfaction, complete denture, implant-retained overdenture, questionnaire

Improvements in medical technology have greatly increased average human life expectancy, meaning that patients now have higher chances of becoming totally edentulous. For edentulous patients who receive dentures, merely providing enough stability and support for the dentures is insufficient; rather, acceptance of dentures requires patients to endure a process of adjustment. The longer that the patients wear complete dentures, the more difficulties they encounter, as the dental ridges become increasingly atrophied.[1] Such atrophy is considerably worse when the patient wears a mandibular complete denture due to tongue mobility issues and decreased contact surface. Combined with other problems relating to neuromuscular coordination and the ability of the denture to form a tight seal with the surrounding soft tissues, patients express much more dissatisfaction with the mandibular complete denture.[2]

Since Brånemark's success with titanium root-form dental implants, however, dental implant therapy has brought new hope for edentulous patients. Dental implant treatment provides patients with better stability and increased biting

From the [1]Department of General Dentistry, Chang Gung Memorial Hospital at Taipei, Chang Gung University College of Medicine, Taoyuan, Taiwan; [2]Department of General Dentistry, Chang Gung Memorial Hospital at Linkou, Chang Gung University College of Medicine, Taoyuan, Taiwan

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Correspondence to: Dr. Chao-Hua Liang, Department of General Dentistry, Chang Gung Memorial Hospital at Taoyuan. 5, Fusing St., Gueishan, Taoyuan 333, Taiwan (R.O.C.). Tel: 886-2-2713-5211ext. 3491. Fax: 886-2-2514-8246; E-mail: alan8302018@gmail.com

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force with the prostheses.[3,4] However, for some edentulous patients with certain unfavorable oral conditions or financial concerns, support for fixed partial dentures is not feasible. Therefore, overdentures retained or supported by implants have been adopted.[5-8]

In general, implant-retained or -supported overdentures can be applied by placing as few as one or up to several implants and then using attachments to provide retention for the denture.[6,7,9-14]

Normally, the critical concerns for most denture-wearing patients relate to appearance, speech, occlusion, and mastication functions.[3,8,15,16] It is common for clinicians to use intraoral condition, such as gingival and periodontal health, and prosthesis condition to evaluate the treatment outcome.[16,17] However, these parameters do not completely reflect the real needs of patients. Even the correlation between clinical test results and patients' self-estimations is low.[8]

Dentists should focus on each patient's opinions regarding the usage of dentures, including opinions regarding comfort levels, appearance, feeling, function, speech, and the patient's confidence, in order to estimate patient satisfaction.[18,19] Manal proposed a self-estimated patient satisfaction rating to analyze the effectiveness of treatment with different types of mandibular implant-retained overdentures.[20] Using such a patient-based outcome not only shows what patients think about the treatment but also provides indications for clinical choices in treating specific kinds of patients. Furthermore, a patient-oriented evaluation is a very important clue regarding the outcome of the treatment as it shows the patient's opinion of the treatment.[21-23] The final goal is to achieve a standard, such that edentulous patients are fully satisfied with the treatment and have a better understanding of the impact of edentulism on the their quality of life.[11]

For this study, we recruited patients who had received an implant-supported mandibular overdenture with distal extracoronal resilient attachments (ERA) (APM-Sterngold) at the Chang Gung Memorial Hospital and then used the overdenture for a period of at least 6 years. In addition, we wanted to examine any correlations between satisfaction with the denture and patient age or gender.

METHODS

This investigation examined patient satisfaction among 60 patients (29 males and 31 females) diagnosed with complete mandibular edentulism who received 240 dental implants. These patients served as the experimental group. Another 25 patients who had previously been treated with conventional mandibular complete dentures were selected as the control group. In order to compare patient satisfaction levels between and within the groups, the subjects in both groups received questionnaires during their visits.

For the experimental group patients, the implants were placed by periodontists in the north branch of the Chang Gung Medical Center during the period from 1999 to 2006. All the patients were followed up within 2, 5, or 6 years. Each patient received preoperative computed tomography (CT) scanning to evaluate mandibular bone density, as well as the thickness and width of the bone.

Each patient was treated with four one-stage titanium sprayed (TPS) or four sandblasted, large-grit, acid-etched (SLA) ITI implants (Straumann Institute, Waldenberg, Switzerland). The implants were placed bilaterally in the region between the mandibular canine and second premolar. The sizes of the implants were chosen from among three diameters (3.1, 4.1, or 4.8 mm), and the implant length was at least 10 mm, based on the nature of the bony architecture. After 3-4 months of healing, the periodontists confirmed that all the implants were clinically osseointegrated with no sign of infection, inflammation, or mobility. The patients were then transferred to the prosthodontic department for definitive restoration.

Four implants, connected with a solid cast Hader bar which employed a midline clip and paired distal cantilever ERA resilient attachments (Sterngold Dental, LLC, Attlebore, MA, USA) as direct retainers, were utilized for the design of the restoration. Follow-up visits were performed every 6 months after delivery of the prostheses and periodically to evaluate clinical complications. Again, questionnaires were given to the subjects during these visits.

In the control group, each of the 25 patients was treated by an experienced prosthodontist, and all the patients had at least 2 years of follow-up. We excluded any patient who received procedures merely to eliminate variation derived from decreasing satisfaction due to the adaptation period for new dentures. All of the patients in the control group received a certified letter describing in detail the purpose and the content of the questionnaire, along with a stamped envelope. Ten of 25 questionnaires were returned via mail, 5 questionnaires were returned during follow-up visits, and 6 questionnaires were returned undelivered, while four patients neither returned for follow-up nor returned the questionnaires via mail.

A comprehensive self-estimated questionnaire was designed to help dentists make this evaluation.[24] According to Boerrigter's method, there are three aspects to consider when evaluating satisfaction with dentures: (1) problems with the denture itself: Any problem or complication resulting from denture usage; (2) masticating ability: Chewing performance when patients eat different kinds of food; and (3) overall denture performance: The physical and life impacts on the patient, derived from the denture.[1] Different answers to each question are assigned scores and the total score can be calculated for further evaluation and analy-

sis.[25,26] Another evaluation method is the so-called Visual Analogue Scale (VAS) described by Grandmont (1994). The two ends (anchors) in a line about 10 cm represent the best and worst, respectively. Patients draw the location between two anchors to represent their feeling for every question. The distances of the location to anchors could be measured and quantified. After quantification, scores can be used to represent patient's satisfaction.[27]

The framework of the questionnaire [Figure 1] consisted of five main parameters.

The content of the questionnaire was reviewed by a periodontist, an oral and maxillofacial surgeon, and three prosthodontists, and the questions were categorized into five areas [Figure 1]. The scores for each question were calculated individually and averaged to obtain the final score.

Cronbach's alpha was used to estimate the reliability of the questionnaire [Figure 2]. $\alpha > 0.9$ was regarded as excellent, $\alpha = 0.8$-0.89 as good, $\alpha = 0.7$-0.79 as acceptable, $\alpha = 0.6$-0.69 as questionable, $\alpha = 0.5$-0.59 as poor, and α value below 0.5 was regarded as unacceptable. Statistical Product and Service Solution Ver. 12 (SPSS12) was used to analyze the results from the survey, and both independent *t*-test and Kruskal–Wallis test were used to evaluate the differences among the means of groups.

RESULTS

In the reliability analysis, 22 questions achieved the first level, 15 fell in the second level, 1 was in the third level, and only 1 was in the fourth level. Question number 9 (Does the denture cause you difficulty in opening your mouth?) was the question in the fourth level. Because most dentists have different evaluation standards for this question, it was deleted for the final version of the survey. In terms of reliability, all the groups had acceptable to excellent levels.

Question category 1: Functional complaints about the dentures

The average response scores in the experimental group and control group were 1.09 and 1.66, respectively ($p < 0.001$). This indicates that the experimental group had significantly lower scores than the control group on this question [Table 1].

Question category 2: Evaluation of overall masticating ability

For the evaluation of masticating ability, the average response score of the experimental group was 1.06. For

1. Functional complaint about the dentures
1-1 Have you had trouble pronouncing any words due to your denture?
1-2 Did your taste change because of your denture?
1-3 Did your denture cause pain or sore spot when wearing?
1-4 Did your denture cause pain or sore spot when eating?
1-5 Did your denture loosen easily when eating?
1-6 Did your denture loosen easily when talking?
1-7 Did you feel difficult to swallow liquid food?
1-8 Did you feel food impact under your denture easily?
1-9 Did you feel difficult to open your mouth when wearing your denture?
1-10 Did you have full moth sensation due to your denture?
1-11 Did you find your denture or teeth clicking when eating or talking?
1-12 Did you find your face change when you were wearing your denture?
1-13 Did you bite your cheek or tongue mucosa easily?
Score: 1–4 (1 = never; 2 = sometimes; 3 = often; 4 = always)
2. Overall masticating ability
2-1 Did you experience difficulty when chewing?
2-2 Did you have problems with drooling?
2-3 Did you take out your denture for eating?
2-4 Did you feel insecure with your denture when eating?
2-5 Has your diet been unsatisfactory because of your denture?
2-6 Have you had to interrupt your meal because of your denture?
Score: 1–4 (1 = never; 2 = sometimes; 3 = often; 4 = always)
3. Masticating ability for different types of food
3-1 Can you eat hard food with your denture?
3-2 Can you eat soft food with your denture?
3-3 Can you eat tough food with your denture?
Score: 1–3 (1 = well; 2 = moderately; 3 = badly)
4. Effect on mental and daily life
4-1 Did you feel tense when wearing your denture?
4-2 Did you find it difficult to relax because of your denture?
4-3 Did you feel embarrassed when wearing your denture?
4-4 Did you get upset by the appearance of your profile?
4-5 Have you been a bit irritable with other people because of problems of your denture?
4-6 Did you have difficulty in your daily job because of problems of your denture?
4-7 Are you afraid to go out with other people because of problems of your denture?
Score: 1–5 (1 = never; 2 = hardly ever; 3 = occasionally; 4 = fairly often; 5 = very often)
5. Overall denture satisfaction
5-1 How many times do you take out your prosthesis because of discomfort?
5-2 How satisfied are you with your maxillary denture?
5-3 How satisfied are you with your mandibular denture?
5-4 How satisfied are you in general with your dentures?
5-5 How satisfied are you with the functional comfort of your denture?
5-6 How satisfied are you about eating with your denture?
5-7 How satisfied are you about speaking with your denture?
VAS (Visual Analogue Scale)
5-8 Were your expectations for your new prosthesis satisfied?
5-9 Would you repeat the same treatment?
Y/N (yes/no)
Note: Questions 5-8 and 5-9 are not included in this analysis because the answers are yes/no.

Figure 1: Framework of the questionnaire

the control group, the average was 1.64. A significant p value ($p < 0.001$) was determined using the t-test. Patients wearing mandibular implant-retained overdentures had a significantly lower mean value than the patients wearing complete dentures in terms of masticating function [Table 1].

Question category 3: Evaluation of masticating ability for different types of food

In the evaluation of masticating ability for different types of food, the average response score of the experimental group was 1. For the control group, the average was 1.92 ($p < 0.001$). Patients wearing mandibular implant-retained overdentures had a significantly lower mean score than the patients wearing complete dentures in terms of masticating ability for different types of food [Table 1].

Table 1: Analysis between functional complaints of the dentures, evaluation of masticating ability, evaluation of masticating type of food, effects on mental and daily life, and overall satisfaction (*N*=75)

	Implant (*n*=60) mean (SD)	Complete denture (*n*=15) mean (SD)	*p*
Masticating ability	1.06 (0.15)	1.64 (0.47)	<0.001
Masticating type of food	1.09 (0.15)	1.92 (0.56)	<0.001
Effect on mental and daily life	1.08 (0.18)	1.42 (0.81)	0.12
Overall denture satisfaction	8.89 (0.31)	6.99 (2.11)	0.004
Functional complaints of denture	1.09 (0.16)	1.66 (0.45)	<0.001

SD: Standard deviation

Table 2: Comparison between genders, analyzing the functional complaints of denture, masticating ability, masticating type of food, and effects on mental and daily life (*N*=68)

	Male (*n*=36) mean (SD)	Female (*n*=32) mean (SD)	*p*
Masticating ability	1.21 (0.40)	1.08 (0.18)	0.09
Masticating type of food	1.28 (0.47)	1.10 (0.17)	0.05
Effect on mental and daily life	1.18 (0.54)	1.09 (0.21)	0.41
Overall denture satisfaction	8.39 (1.59)	8.85 (0.38)	0.09
Functional complaints of denture	1.24 (0.41)	1.11 (0.14)	0.08

SD: Standard deviation

Question category 4: Effects on mental and daily life

In an analysis of the effects on mental and daily life, the mean score for the experimental group was 1.08. For the control group, the average was 1.42 ($p = 0.12$). Although patients wearing mandibular implant-retained overdentures had a lower average score than the patients wearing complete dentures in terms of the effects on mental and daily life, there was no significant difference in this category [Table 1].

Question category 5: Analysis of overall satisfaction

The mean score for the experimental group was 8.89. For the control group, the average was 6.99. The t-value was 3.479 and the p value was 0.004. Because the p value was smaller than 0.05, it was concluded that the patients wearing mandibular implant-retained overdentures were more satisfied than the patients wearing complete dentures. In addition, this result was statistically significant [Table 1].

Analysis of the differences based on gender

Each category was evaluated based on gender. No significant difference was noted [Table 2].

Analysis of the differences based on age

According to their ages, patients were divided into four subgroups (40-49, 50-59, 60-69, and 70-79 years). According to Kruskal–Wallis test analysis, there was no significant difference among patients in the different age groups [Table 3].

Analysis of expectation

Among the 60 patients in the experimental group, 59 felt that the treatment fulfilled their expectations. If given an opportunity to choose again, 58 patients would make the same choice, but the other two wanted to have a different type of treatment.

Table 3: Comparison between age groups, analyzing the functional complaints of denture, masticating ability for different types of food, and effects on mental and daily life (*N*=60)

Age group	40-49 (*n*=4) median (IQR)	50-59 (*n*=24) median (IQR)	60-69 (*n*=25) median (IQR)	70-79 (*n*=7) median (IQR)	*p*
Masticating ability	1 (1-1.13)	1 (1-1.13)	1 (1-1)	1 (1-1)	0.90
Masticating type of food	1 (1-1.19)	1 (1-1.19)	1 (1-1.13)	1 (1-1.13)	0.88
Effect on mental and daily life	1 (1-1)	1 (1-1.11)	1 (1-1.14)	1 (1-1)	0.68
Overall denture satisfaction	8.92 (8.08-9)	9 (9-9)	9 (8.92-9)	9 (9-9)	0.37
Functional complaints of denture	1.13 (1.02-1.48)	1 (1-1.15)	1 (1-1.17)	1 (1-1.25)	0.39

IQR: Interquartile range

DISCUSSION

This investigation found that patients wearing the implant-supported overdentures received better scores for each type of analysis conducted than the patients wearing a complete denture. Among the five question categories, three analyses showed noticeably significant differences ($p < 0.001$) and one analysis showed a significant difference ($p < 0.05$). Only one analysis showed no significant difference ($p > 0.05$). The study by Boerrigter *et al*. made a comparison of mandibular implant-retained overdentures and complete dentures, with five out of seven analysis categories showing a statistically significant difference. Similar results were obtained in the present study.

In 2002, Raghoeber showed that mandibular implant-retained overdentures performed better than complete dentures in the first and fifth years after treatment, both in clinical performance and patient satisfaction. In addition, the mandibular implant-retained overdentures continued to show a better score than the complete dentures in the tenth year, although the difference was less significant.[28] For this reason, we chose patients who had been wearing conventional complete dentures for more than 2 years as controls.[17] In this way, we were able to minimize the effects of differences resulting from patient adaptability.

In 2004, Timmerman published a randomized controlled trial study comparing two mandibular implant-retained overdentures with a ball or bar attachment to a four mandibular implant-supported overdenture with three bar-and-clip attachments.[11] Although there was no significant difference among these three treatments, patient satisfaction in terms of retention and stability with the mandibular four implant-supported overdenture was much better than for the other treatments after 8 years. This result also demonstrated that this design was more stable. For this reason, the present study adopted overdentures supported by four implants and retained by one bar-and-clip type with two distal ERA attachments for our experimental group. As a result, the stability and retention were increased.[15] The reason that we chose ERA is because it is easy to repair while maintaining the capacity to provide excellent results compared with other designs.

When sorting the 12 questions about the functional problems caused by dentures according to their scores, it was found that swallowing status had the best score for both the experimental and control groups [Figure 2]. This might have been due to the expertise of the treatment providers. They designed appropriate extension edges for the dentures, so that patients could swallow smoothly. The poorest scored question was one which found that foods usually seeped under the dentures when the patients were eating. Although the mandibular implant-supported overdentures improved the

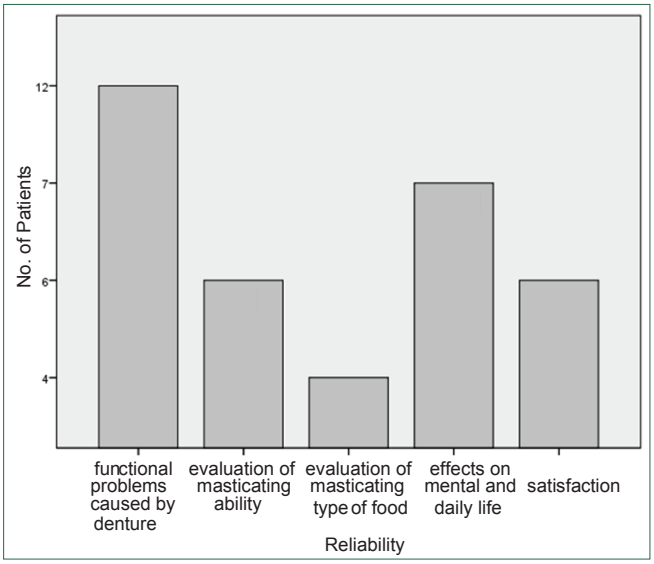

Figure 2: The Cronbach's α value for reliability ($N = 60$)

patients' eating ability, this seepage problem was difficult to resolve. This is because the original designs for mandibular implant-supported overdentures came from complete dentures, such that they still cannot prevent micro-movements of the dentures. However, in a comprehensive view, the mandibular implant-supported overdenture is significantly better, statistically, than the complete denture in terms of function and satisfaction.

Question number 9 was disregarded in the final analysis. Two problems were identified with this question. First, patients might not have fully understood the question due to its vague phrasing, and several issues, such as Temporomandibular Disorders (TMD) or submucosa fibrosis, might cause difficulty in terms of opening the mouth. This investigation was only focused on the problems caused by dentures, but the patients might have been misled by other factors. Second, if dentures actually caused the mouth-opening problem, that problem should have been addressed at the beginning of treatment.

When wearing dentures, an inability to fulfill the requirements for eating all kinds of food was the most noted problem in terms of chewing. This is because the dentures are usually made of acrylic resin, in which case, there are definitely some restrictions on the foods one can eat. In particular, when a complete denture relies entirely on support from the mucosa, there will be even more discomfort in chewing food.

An interesting result was that denture instability during eating for the control group was better than expected. The reason for this could have been that the majority of the patients in the group had worn dentures for at least 2 years. Therefore, most of the patients were already used to their dentures. In addition, the mucosa and the alveolar bone under the dentures may have conformed to the tissue surface of the denture, thus enhancing denture stability.

In terms of masticating ability for different food types, soft foods had the best score while hard and sticky foods had the lowest score. Similar results have been found in most other studies. Awad studied 102 patients (48 wearing complete dentures and 54 wearing mandibular implant-retained overdentures) and applied VAS to evaluate the masticating ability for different food types.[29] He found that both the complete denture and the mandibular implant-retained overdenture performed better when patients were eating hard or soft foods, such as apples or cheeses. In addition, he also showed that the mandibular implant-retained overdenture group performed significantly better than the complete denture group in every respect.[24,29,30]

With respect to the effects on mental and daily life, the average score for mandibular implant-retained overdentures was better than for the conventional complete denture. However, there was no significant difference between the groups. A similar result was found by Heydecke in an analysis of 60 seniors (30 with complete dentures and 30 with implant-retained overdentures). According to an analysis of mental and social ability using the OHIP-20 (oral health impact profile), patients wearing mandibular implant-retained overdentures had better performance. However, there was no significant difference between the two groups.[31] The daily lives of patients were affected because they felt exogenous obstacles and became restless. For this reason, a dentist must be aware of this potential problem during treatment. If patients cannot accept the feeling of having the bulky exogenous obstacle in the mouth, it is suggested that treatment with implant-supported fixed partial dentures be considered if necessary.

Among a total of 75 patients who responded to the questionnaire, the average overall satisfaction score was around 8.0, indicating that patients were satisfied in general. However, the individual differences among patients wearing complete dentures were notable. Some patients were very satisfied, while some felt that the treatment was a failure. One possible reason for these differing reactions is the variations in dental anatomy among patients.[32,33] In addition, there was insufficient data about each patient's occluding pairs, occlusal patterns, or ridge condition. More evaluations are needed to account for these factors in the future. Finally, the results also showed that the mandibular implant-supported overdenture was deemed significantly better than the complete denture in this category.

No gender-based difference was observed in our study. However, some previous studies have indicated that male patients are more satisfied than female patients. One possible reason for this difference is that most females are much more aware of pain and operations. Therefore, non-surgical treatments will be the first choice for elderly female patients.[34]

Most previous studies on patient satisfaction have only reported the average age of the participants, but differences in satisfaction levels among different age groups have not been previously studied. Some textbooks have suggested that older patients may have poor satisfaction levels due to their physical and dental conditions. In the present study, the masticating type, masticating ability, and mentality scores were found to be worse among older patients. However, there was no significant difference in responses based on age in the present study, in spite of the fact that in order to decrease the effect of testing numbers, we divided the patients into only two age groups (below or above 60 years of age). Even with that adjustment, we still found no significant difference based on age.[35]

In general, patients' expectations were not equal to their levels of satisfaction. A given patient's expectations may be affected by a number of factors, such as education level, age, personal preferences, finances, physical issues, oral hygiene, and the given dentist's ability. Every patient should be treated on a case-by-case basis.

This study shows that a treatment entails a unique connection between a dentist and the patient. A good dentist has to consider the given patient's specific requirements. In the view of most dentists, the survival rate of dental implants, the life span of dentures, and treatment complications are the most important considerations. However, what patients are concerned about the most are how many benefits the treatment will provide and whether the costs are worthwhile. Moreover, considerations of how the treatment could possibly affect the patient's social life and mental well-being are paramount. Therefore, dentists should evaluate a given treatment with function, esthetics, and the patient's feelings and expectations in mind.

Conclusion

This investigation showed that the mandibular implant-retained overdenture is better than the traditional complete denture in every respect from a patient's point of view. For completely edentulous mandibular patients, an overdenture supported by four implants and retained by a bar and clip with distal ERA attachment can be recommended as a viable option.

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