Prosthetic Treatment Time and Satisfaction of Edentulous Patients Treated with Conventional or Implant-Supported Complete Mandibular Dentures: A Case-Control Study (Part 1)

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***Purpose*:** The aim of this study was to compare prospective treatment with implant-retained mandibular overdentures (IROs) versus conventional complete dentures (CDs). This paper reports on the study design and 1-year outcomes. Part 2 in this series will report the 7-year outcomes. ***Materials and Methods*:** Sixty edentulous patients with severely resorbed mandibles, already using a conventional CD, participated. Thirty patients received an IRO and 30 received a conventional CD. The patients were retrospectively matched for age, gender, and social class. The length of each treatment session was recorded. Both groups provided a subjective assessment of their current dentures, and satisfaction with their new dentures was evaluated using questionnaires focusing on denture-related complaints and a general satisfaction scale. ***Results*:** Patients with IROs were more satisfied with the performance of their dentures than those using conventional CDs, especially with regard to subjective fit, looseness, and quality of chewing; however, more clinical treatment was required. The mean time taken by the prosthodontist to construct CDs was 268 minutes, compared to 327 minutes for IROs, to the time of the second review appointment after insertion. ***Conclusions*:** Mandibular IROs provided enhanced performance but required more clinical resources. *Int J Prosthodont 2008;21:489–495.*

Treatment with implant-supported prostheses is now a widely accepted clinical procedure with a high degree of predictability.[1,2] However, there are few published objective assessments of the relative benefits of using implants to support complete mandibular dentures versus the conventional technique, or of the additional resources that this procedure requires. Such studies would enable more rational decisions to be made as to best practice in the use of this treatment modality, in line with current views on evidence-based care.

The use of a minimal number of implants to support a complete mandibular denture is widely considered to have a particularly favorable cost-to-benefit ratio.[3–8] Evidence for this is largely anecdotal; it is therefore an important area for investigation. This is especially so, as the problem of the troublesome complete mandibular denture is often unresolvable by other techniques. Yet it is a clinical problem that will present increasingly for some time in many countries.[9]

The study was designed as a prospective case-control investigation and the patients have been followed for 7 years to date. The first part of the paper reports on the study design and outcomes after 1 year, and the second reports on the outcomes after 7 years.

The objectives of the project were to compare the inputs and outcomes for treatment of edentulous patients with either conventional complete dentures (CDs) in both arches or a mandibular implant-retained over-

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denture (IRO) and a conventional maxillary CD. The following data were collected: (*1*) resources used, and (*2*) subjective assessment of outcome.

Materials and Methods

The subjects were drawn from patients referred by their dental practitioner to the Prosthetics Department of the Eastman Dental Hospital for the provision of maxillary and mandibular CDs. They had been referred because this treatment was considered beyond the scope of the average general dental practitioner. It is the policy of the department, as agreed with National Health Service (NHS) funding agencies, to initially provide all such patients with new CDs when those provided prior to referral are considered by a specialist to be unsatisfactory. If either the existing satisfactory dentures or the new prostheses do not provide adequate performance, then the possibility of implant treatment is explored. When the patient expresses an informed interest in such a procedure and in the opinion of a specialist the patient is likely to benefit from a mandibular IRO, then funding is sought for this treatment under the NHS scheme. For the purposes of this study the first 4 suitable patients attending each month who were offered and indicated that they wished to proceed with implant-based treatment were allocated directly to the study.

While it was impossible to exclude patients who had some prior knowledge of dental implant treatment from the study, patients who had been referred specifically for possible IRO treatment were excluded, as they might have had previous opinions about such treatment that would have affected the perceived outcome of their care. Similarly, patients who had been referred for treatment with CDs but who voluntarily requested implant treatment were excluded from the group of patients who were treated with CDs. All treatment was provided free of charge to the patients to eliminate financial factors from treatment decisions and outcome measures.

Thirty patients were treated with implants, and a further 30 were used as matched controls, described as conventional treatment. The latter were drawn retrospectively from patients referred for treatment with conventional CDs during the period of recruitment to the study. The 2 groups of patients were thus not totally comparable, since one had been deemed likely to be helped with implant treatment and the other initially with CDs, although both had been referred on a similar basis. This problem could only have been overcome by drawing the 2 groups from patients assessed as likely to benefit from implant treatment, but denying one group that opportunity for research reasons. This was considered to be ethically unacceptable.

The patients included in the study were aged between 36 and 75 years. They were free of any known systemic or local diseases that might have affected the outcome of implant treatment or their ability to participate in the study. All had a good standard of oral and denture hygiene and met local criteria for implant treatment, ie, the patients were chronic CD wearers who continued to have problems and, in the opinion of a consultant in restorative dentistry, would benefit from implant treatment. In addition, several principal but not absolute contraindications to implant treatment were applied. Systemic contraindications included (*1*) inability of the patient to cooperate with treatment; (*2*) short residual life expectancy as a result of systemic disease; (*3*) conditions and medication that may adversely affect the patient's healing processes; (*4*) psychiatric disorders; (*5*) tobacco smoking; and (*6*) unrealistic patient expectations of implant treatment. Local factors for exclusion were (*1*) poor oral hygiene; (*2*) lack of bone quantity or quality to place implants, and where bone augmentation would be inappropriate; (*3*) lack of space to restore implants satisfactorily; and (*4*) limited mouth opening.

Three patients in the implant group and 5 in the control group had a history of tobacco smoking. The implant patients stated that they had given up smoking some months prior to treatment, although no tests were conducted to verify this. The mandibular bone was of adequate quantity and quality at the implant sites and the bone height was at least 7 mm in these regions.

In view of the importance of social and economic factors in prosthodontic practice[10] the following criteria were used to match the controls with patients who received implant treatment: (*1*) age: patients' age was matched to within 2 years; (*2*) gender; and (*3*) social class, based on occupation, spouse's occupation, age on leaving school, and education. Because this project was one of a number assessing various aspects of prosthetic treatment, data had been collected for treatment times and laboratory support for all patients attending for CD treatment during the period of recruitment to this study. This enabled retrospective matching, which was used as it enabled a closer pairing than if this had occurred prospectively at the time each patient was allocated for implant treatment, since a larger pool of patients was available from which to draw the controls.

The investigation was conducted with the approval of the Eastman Dental Institute and Hospital Joint Research and Ethics Committee.

Treatment Procedure

Patients were treated by 2 senior specialist staff members in the Prosthetics Department of the Eastman Dental Hospital, with 16 and 22 years of experience in

implant treatment, respectively, at the start of the investigation. A treatment protocol based on the guidelines published by the British Society for the Study of Prosthetic Dentistry[11] was followed.

Two endosseous implants were placed in the interforaminal region, and a 2-stage surgical technique was employed, with an interval of 4 months for healing prior to stage 2 surgery. Treatment was carried out using Southern Implant components with a ball-and-socket attachment to the overdenture (OB2 abutments with plastic polytetrafluoroethylene clip, Southern Implants) (Fig 1). The plastic clips were located within the prosthesis in the laboratory using the master cast, as they could not readily be picked up in the working impression because of their strong retention.

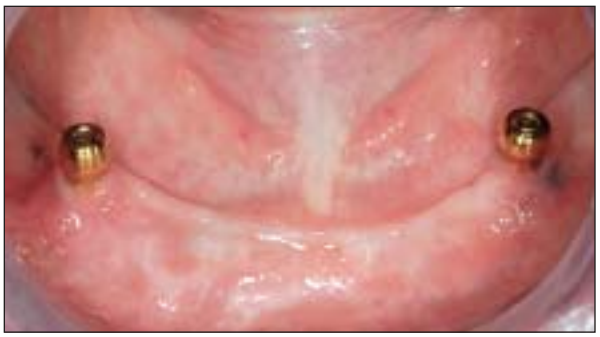

Fig 1 Edentulous jaw with 2 implants in situ.

Inputs and Outcomes

The following measures of inputs and outcomes were recorded for the IRO patients and the CD patients.

1. **Resources used.** A log was maintained for each patient in which data relating to every visit was recorded. This included information on the procedures employed and the duration of the appointment. Data collection was standardized, and patient arrival and leaving times were recorded. All laboratory support was provided in house and was similarly monitored as part of a study on the use of this resource. The study did not include measurement of the additional time related to the planning of implant treatment, implant surgery, or the associated aftercare, as this has been well-documented.[12] The length of unscheduled appointments was included in the data.
2. **Subjective assessment.** Denture satisfaction was assessed using a questionnaire based on a subset of a validated questionnaire.[13] This was used because the questions selected were relevant to this investigation and because a pilot study had determined that many patients found a longer form daunting. The questionnaire (Fig 2) consisted of 20 items and focused on the function of maxillary and mandibular dentures separately and on specific features of their perceived performance, such as retention, functional comfort, and appearance. Each item was presented with a 3-point rating scale on which the patient indicated to what extent he or she was satisfied/dissatisfied with the respective denture. This design was used to obtain direct feedback regarding overall perceptions of the care provided, highlight specific areas of the treatment process, and allow patients to freely express any other opinions. The questionnaires were mailed to the patients 6 months after the end of treatment to allow for a period of adjustment. Any patients who did not respond within 1 month received 2 follow-up letters, and attempts were also made on 3 occasions to contact patients by telephone. This method resulted in some dropouts because of patients losing contact or being unwilling to help (10 patients). Two patients also died prior to data collection, and 2 were seriously ill and unable to assist.

   The questionnaire covered 4 domains:

   1. Complaints, mandibular denture. This domain consisted of 4 items concerning functional problems, for example, "looseness" or "soreness of the gums under the denture." Each item could be answered on a 3-point rating scale (0 = not a problem, 1= some problem, 2 = a problem), which was also used for the next 2 domains.
   2. Complaints, maxillary denture. This scale consisted of 4 items concerning functional problems, for example, "food gets under the upper denture" or "the upper denture moves during speaking."
   3. Functional complaints in general. This domain consisted of 6 items concerning functional problems with the dentures as a whole, for example, "the dentures interfere with speech" or "the dentures feel too much of a mouthful."
   4. Esthetics. This domain consisted of 2 items concerning the esthetics of the dentures themselves, for example, "the dentures look satisfactory compared to natural teeth" to "the dentures look satisfactory compared to previous dentures." Each item could be answered on a 3-point rating scale (0 = better, 1 = the same, 2 = worse).

3. **Treatment failure.** Failures of both the IROs and the CDs were recorded.

1. Do you have any problems with your new dentures?
☐ Yes ☐ No

If no, then go to question 17.

2. Looseness of the upper denture
☐ Not a problem ☐ Some problem ☐ A problem

3. Looseness of the lower denture
☐ Not a problem ☐ Some problem ☐ A problem

4. Soreness of the gums under the upper denture
☐ Not a problem ☐ Some problem ☐ A problem

5. Soreness of the gums under the lower denture
☐ Not a problem ☐ Some problem ☐ A problem

6. Soreness of the roof of your mouth (palate)
☐ Not a problem ☐ Some problem ☐ A problem

7. Food gets under the upper denture
☐ Not a problem ☐ Some problem ☐ A problem

8. Food gets under the lower denture
☐ Not a problem ☐ Some problem ☐ A problem

9. The upper denture moves when you talk
☐ Not a problem ☐ Some problem ☐ A problem

10. The lower denture moves when you talk
☐ Not a problem ☐ Some problem ☐ A problem

11. Wearing the upper denture makes you feel sick.
☐ Not a problem ☐ Some problem ☐ A problem

12. The upper denture keeps breaking.
☐ Not a problem ☐ Some problem ☐ A problem

13. Difficulty chewing with the back teeth.
☐ Not a problem ☐ Some problem ☐ A problem

14. The dentures interfere with your speech.
☐ Not a problem ☐ Some problem ☐ A problem

15. The dentures feel too much of a mouthful.
☐ Not a problem ☐ Some problem ☐ A problem

16. Your face aches after wearing them for some time.
☐ Not a problem ☐ Some problem ☐ A problem

17. How do your dentures look compared with your natural teeth?
☐ Worse ☐ The same ☐ Better

18. How do your new dentures look compared with your old dentures?
☐ Worse ☐ The same ☐ Better

19. How do your new dentures chew compared with your natural teeth?
☐ Worse ☐ The same ☐ Better

20. How do your new dentures chew compared with your old dentures?
☐ Worse ☐ The same ☐ Better

Fig 2 Questionnaire used by the subjects.

Table 1 Characteristics of the Study Sample

	Implant	Control	Total
Mean age (y) (SD)	61.1 (9.45)	64.75 (9.78)	64
Gender (m/f)	8/21	8/21	16/42
Length of edentulism (y)	25.6	29.9	
Smoking	3	5	8
Symphyseal height (mm)	21.32	23.35	
Died during study period	1	1	2
Ill during study period	1	1	2
Excluded	1	1	2
Treatment failure	1	—	1

Statistical Analysis

Data were entered into SPSS analysis software (version 11.0 for Windows, SPSS Inc) for subsequent analysis.

Results

The results of statistical analyses are presented in Tables 1 to 3.

Overall, the 2 groups were well-matched on potential confounding factors. Thirty were assigned to the implant treatment, and 30 were assigned to the CD group. After being assigned to treatment, 2 patients subsequently died during the study period (1 in the implant group and 1 in the control group), 2 became critically ill, and 2 were excluded for nonattendance. The overall mean age of the study population was 64 years (standard deviation, 9.45). Only 47% of the implant patients reported problems with their dentures, compared to 81% of the CD patients.

1. Resources Used

The time taken by the prosthodontist was calculated for each visit. For each procedure, the additional time spent in minutes was calculated by subtracting the time taken for the implant patient from that for the matched CD patient. Data were analyzed using a paired *t* test, the results of which are shown in Table 2. Negative numbers indicate that more time was taken when treating the implant patient. Table 2 shows that there were significant differences between the IRO group and the CD group for the second try-in, the second review, and the total clinical time taken. The other stages of treatment showed no significant differences between the 2 groups. The average time taken by the technician for the IROs, up to the second review visit, was 20 minutes greater than for the CDs.

Table 2 Time Differences (Min) Between Conventional Denture Subjects and Implant Subjects for Each Procedure

Appointment	Mean difference	Lower 95% CI	Upper 95% CI	*P*
First impression difference	−3.83	−9.45	1.80	.174
Second impression difference	0.79	−7.74	9.33	.850
Registration difference	−5.48	−13.70	2.74	.183
Try-in 1 difference	1.21	−4.78	7.19	.683
Try-in 2 difference	15.00	7.04	22.96	.001
Insert denture difference	2.24	−5.59	10.08	.563
Review 1 difference	2.07	−3.72	7.85	.470
Review 2 difference	8.28	2.43	14.12	.007
Total difference	−45.07	−79.76	−10.38	.013

Paired-sample *t* test.

Table 3 Differences in Complaint Scores Between Conventional Denture Subjects and Implant Subjects

Appointment	Mean difference	Lower 95% CI	Upper 95% CI	*P*
Loose upper difference	0.10	−0.27	0.47	.573
Loose lower difference	0.38	0.01	0.75	.046
Soreness upper difference	0.28	−0.06	0.61	.103
Soreness lower difference	0.24	−0.09	0.57	.147
Soreness roof difference	0.00	−0.20	0.20	>.999
Food under upper difference	0.14	−0.22	0.50	.442
Food under lower difference	0.14	−0.28	0.55	.502
Moving upper difference	0.10	−0.11	0.32	.326
Moving lower difference	0.10	−0.13	0.34	.375
Sickness with upper difference	0.14	−0.13	0.40	.293
Breaking upper difference	0.03	−0.04	0.11	.326
Difficult chewing difference	0.28	−0.09	0.64	.133
Speech interference difference	0.24	−0.02	0.50	.070
Dentures mouthful difference	0.07	−0.32	0.46	.722
Face aches difference	0.31	−0.03	0.65	.071
Appearance compared to natural dentition	0.17	−0.25	0.59	.408
Appearance compared to old denture	0.14	−0.14	0.42	.326
Chewing compared to natural dentition	0.55	0.07	1.03	.027
Chewing compared to old denture	0.41	0.07	0.76	.020
Total difference	3.83	0.24	7.42	.038

Items refer to questions shown in Fig 2.
Paired-sample *t* test.

2. Subjective Assessment

The patient satisfaction questionnaire was completed by 19 IRO patients and 22 CD patients. Of the remaining patients, 2 failed to complete treatment (1 CD and 1 IRO), 1 in each group had died, and 1 in each group had become critically ill. It proved impossible to elicit a response from the remaining patients, 8 of whom were in the IRO group and 5 of whom were in the control group.

The results of the subjective assessment are shown in Table 3. There was a significant difference between the IRO group and the CD group regarding complaints of looseness of the mandibular denture and difficulty chewing, whether the denture was compared to the old prosthesis or to the natural dentition. There was also a significant difference in the total overall difference scores. The other factors showed no significant difference between the groups (Fig 2).

3. Treatment Failure

Both implants failed in 1 subject. This patient was not a smoker, and the reasons for failure were unexplained.

Discussion

Subjective Assessment

Few studies have compared IRO treatment to CD treatment with respect to patients' views. Blomberg and Lindquist[14] studied patients' reactions before and after placement of IROs. The majority of the patients reported an improvement in quality of life, self-confidence, and acceptance of the prosthesis as a part of themselves. Since then, increased satisfaction has been found in groups provided with fixed superstructures[15] and mandibular IROs.[16]

The present study was a comparison of matched pairs that took into account other circumstances. It showed that the implant group was highly satisfied in comparison to the CD group, and that there was a significant difference regarding perceived looseness of the mandibular denture. The subjective fit of the mandibular denture was improved and the subjective quality of chewing was also significantly improved with IROs versus CDs.

Resources Used

This study showed that there was a significant difference in staff time used between the IRO group and the CD group, despite the extensive experience of the 2 clinicians who carried out the procedures. The implant treatment took more time at the second try-in and the second review stages. However, the duration of IRO fabrication was lengthened by the making of a wash impression in the trial denture to record the implant positions. The total time taken for implant patients up to 2 reviews after insertion was more than for the conventional procedures, and this was a statistically significant difference. The other clinical stages showed no significant difference between the groups.

An earlier American study[17] reported that the mean time taken by a clinician to construct CDs was 308 minutes. The current study found that the mean time taken to construct CDs was 268 minutes; for IROs up to the second review after insertion, 327 minutes were used. Data reported by Takanashi et al[18] provided similar figures, with 282 minutes for CDs and 296 minutes for IROs with up to 2 reviews by a clinician working alone. Van der Wijk et al [4] found that 1 prosthodontist and 1 dental assistant working together spent a total of 286 minutes for the CD, from the time of first examination to the second review after insertion. They determined the costs associated with the provision of bar-retained 2-implant overdentures and found a 42-minute difference in time spent by the prosthodontist to provide the IROs compared with CDs, including the 1-year follow-up visit. This is only 17 minutes different from the time found in this study; however, they suggested that it was possible that the extra time taken in their study may have been needed to adjust the retention bar during the try-in appointment.

Study Design

This study was designed to be as robust as possible by removing, where feasible, any variables not under investigation. The design was therefore prospective, using patients who had no expectations of implant treatment and for whom this was provided free of charge. The controls were matched retrospectively as closely as possible using the parameters described earlier. While it would have been theoretically preferable to randomly allocate subjects to either group, the relatively small number of subjects for whom funding was available and the range of characteristics of the referred patients meant that a closer match was achieved by retrospective matching from within the pool of referred cases. Treatment was carried out by specialists with at least 16 years of experience in implant prosthodontics using a standard protocol. The subjects and controls were selected initially by their dental practitioners, who had made the decision that the patients' prosthetic treatment was beyond their skills. Given the multiple factors that inform such a decision, these criteria may not be particularly robust, and no attempt was made to match the referring practitioner for each of the 2 groups, since the wide referral base and turnover of dental practitioners in the southeast of England made this unfeasible. Nevertheless, it was considered reasonable to assume that the basis on which the patients in each group were referred was broadly similar.

The questionnaire used a subset of a published and validated scheme and thus was comparable within the context of the questions used. The decision to issue the questionnaire by mail had the advantage of enabling data to be collected after the patients had been able to use their new prostheses for a while. However, despite telephone reminders, this resulted in a loss of data, as not all patients responded, although this affected both the implant and control groups to a similar degree.

Conclusions

1. In this study, patients provided with implant-supported overdentures were more satisfied than those given conventional dentures.
2. The total chairside time needed by the clinician to treat the implant cases was more than that required for the conventional denture cases.

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