Comparative Study between Different Denture Adhesives in Improving Phonation in Complete Denture Wearers

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Abstract: Objectives: the aim of this study was to evaluate the efficiency of denture adhesives in improving phonation in complete denture wearers and to compare the efficacy of three different types of denture adhesives. Methodology: Fifteen completely edentulous patients with flat mandibular ridge shared in this study, complete denture was constructed for each patient according to the conventional method. Phonetic analysis was performed in the Phoniatric Unit via both Perceptual and Acoustic techniques to compare the efficacy of three chemically different denture adhesives (Super corega, Fittydent and Fixodent) on Arabic phonemic production. Results: a marked improvement in patients' articulation after application of the denture adhesives was reported, perceptually and acoustically, where the Fixodent denture adhesive gave the highest values. Conclusion: Whenever possible, denture adhesives should be used to improve retention and articulation. The polymethylvinyl ether malate-based adhesives (Fixodent) are strongly recommended as a highly reliable type of denture adhesives.
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1. Introduction:

Residual ridge resorption is considered a major oral disease which could occur despite of careful prosthetic handling[(1)]. One of the most undesirable effects of residual ridge resorption is compromised denture retention which is considered a real challenge in complete denture therapy. There is always a question asked by the patients even in there own minds when they are seeking a prosthetic therapy which is "Is this denture going to be retentive?" Patients are asking for retention during talking, laughing, speaking, and for sure eating, regardless the condition of their remaining tissues (alveolar ridge height and soft tissue condition) [(2,3)]. Improving retention in cases of residual ridge resorption could be achieved via either surgical and/or prosthetic treatment. Surgical treatment may be in the form of vestibuloplasty[(4)], ridge augmentation[(5)], endosseous dental implants[(6)]. Anatomic, systemic and / or financial limitations could interfere with the surgical techniques described for flat ridge cases[(7)]. Denture adhesives had been used to aid in complete denture retention long time ago [(8,9)]. Wilson et al, [(10)] reported that 30% of the patients wearing dentures used denture adhesives. Another study declared that out of the 20% of the adult population in US who wear dentures at least 22% used denture adhesives [(11)]. Slaughter et al, [(12)] reported that the use of denture adhesives is considered suitable, adjunctive and effective treatment modality in removable prosthodontics. Denture adhesives are commonly composed of three main components [(13)]:

a - basic adhesive substance such as methyl cellulose, sodium carboxy methyl cellulose, hydroxy methyl cellulose and/or synthetic polymers such as polyethylene oxide, acrylamides and polyvinylmethylether Maleic Anhydride.

b- Antimicrobial agent: such as hexachlorophene, sodium borate, ethanol and sodium tetraborate.

c- Preservatives, flavouring agents, wetting agents and plasticizers.

Many studies reported the effect of denture adhesives on improvement of mastication, [(14-16)] but their effect on Pronunciation of different phonological sounds is still lacking.

2. Materials and methods:

Fifteen patients (10 females and 5 males) were selected from the outpatient prosthodontic clinic, faculty of Oral and Dental Medicine, Cairo University. Their ages were ranging from 54 to 73 years with a mean age of 61.5 years. They were all completely edentulous with flat mandibular ridge, construction of complete dentures was carried out according to the conventional method. Phonetic assessment for the fifteen patients was carried out in the Phoniatric unit, faculty of medicine, Cairo University via both perceptual (subjective) and acoustic analysis (objective) methods in five phases:

Phase 1: before denture delivery while the patients were still unrestored completely edentulous.
Phase 2: two weeks after the final denture inspection.
Phase 3: two hours after application of the denture adhesive type 1 (Super corega) which is based on Carboxymethyl cellulose (CC).
Phase 4: this was done one week later, two hours after the application of adhesive type 2 (fittydent) which is based on Sodium Carboxymethyl cellulose and polyvinylacetate.
Phase 5: this was done one week later, two hours after the application of adhesive type 3 (Fixodent) which is based on sodium Carboxymethyl cellulose and polymethylvinylether maleate.

Application of each type of denture adhesive type was done on clean fitting surface according to the manufacturer recommendation (Figure 1).

Figure (1), Application of the denture adhesive of the lower complete denture.

Phonetic assessment:
I- Subjective perceptual assessment of different Arabic phonemes using the Arabic Articulatory Test (AAT). [17] Consonant sounds were sampled in initial, middle and final positions of words. The patients' products were tape-recorded and the test was transcribed on line followed by analysis of the recorded tape to verify the on-line transcription.
II- Objective acoustic assessment from a wide-band spectrogram display, using the Computerized Speech Lab (CSL) Kay model 4300, (Figure2). Acoustic analysis of the perceptually-detected mostly affected phonemes (/s/, /ş/, /z/, /ʃ/) was performed in the initial and the terminal–word positions. The full word was displayed on the screen and then the target sound was zoomed in. The segment was visually and auditory verified to ensure that both the beginning and the end of the sounds were included. Cursors were placed at the initial and the terminal of the target phonemes. The following acoustic parameters were analyzed: 1-Average energy in (dB), which reflects the sound volume over a period of time. 2-Average duration in (mSec), which reflects the time required to produce a given speech sound. Subjects were instructed to repeat target words containing the consonants which appeared to be affected during perceptual assessment. The words were put in a carrier phrase (say ……again) to ensure a standard way of utterance.

Data were presented as mean and standard deviation (SD) values. Analysis of variances with repeated measures ANOVA was used and Bonferroni's test for pair-wise comparisons. The significance level was set at $P \leq 0.05$.

Figure (2) Computerized speech lab (CSL).

3. Results:

Results of the perceptual assessment using Arabic Articulatory Test [17] revealed that only four fricatives were mostly affected from the whole 23 tested Arabic phonemes; they were /s/, /ş /, /z/and /ʃ/, in 100% of completely edentulous patients. The same phonemes were affected after wearing the dentures without denture adhesives in all the patients. Marked perceptual improvement in phonemes was noticed after application of every adhesive type; 100% of patients improved in /s/sound, 95% in / ş / sound, 100% in /z/ sound and 100% in /ʃ/ sound, however, there was no perceptual difference in phonetic improvement between the three types of adhesives.

Adhesive type 1: (Super corega) which is based on Carboxymethyl cellulose (CC).

Adhesive type 2: (fittydent) which is based on Sodium Carboxymethyl cellulose and polyvinylacetate.

Adhesive type 3: (Fixodent) which is based on sodium Carboxymethyl cellulose and polymethylvinylether maleate.

Table (1): The total duration of the tested phonemes (/s/, /ş/, /z/, /ʃ/) in initial and terminal–word positions in patients; without dentures, with dentures without adhesive and with three types of denture adhesives.

Groups	Duration of initials in (m sec)		Duration of terminalsin (m sec)	
	Mean	SD	Mean	SD
Patients Without denture	0.24 [b]	0.03	0.34 [b]	0.03
Patients With denture (no adhesive)	0.28 [a]	0.02	0.39 [a]	0.04
Patients With denture With Adhesive type 1	0.21 [c]	0.03	0.29 [c]	0.04
Patients With denture With Adhesive type 2	0.22 [c]	0.02	0.28 [c]	0.02
Patients With denture With Adhesive type 3	0.18 [d]	0.04	0.24 [d]	0.03

Means with different letters are statistically significantly different according to Bonferroni's test ($P \leq 0.05$).

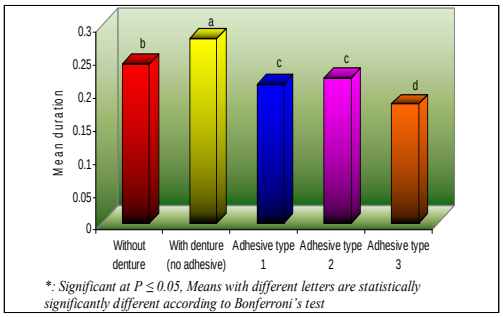

Figure (3) Duration of initials.

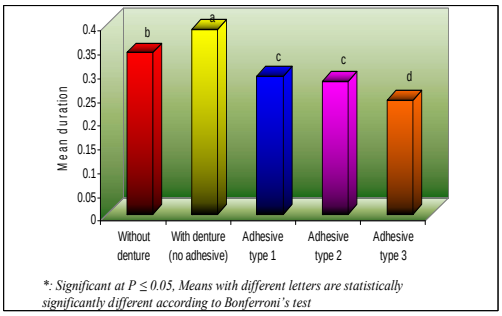

Figure (4) Duration of terminals.

Results of the total duration of the acoustically tested phonemes (/s/, /ş/, /z/, /ʃ/) in the initial and the terminal–word positions, as seen in Table (1), Figure (3,4) revealed a highly significant increase in the mean duration in patients with denture without adhesive (which showed the highest mean duration among the five groups) compared to patients without denture. There was a highly significant decrease in the mean duration value in patients with denture with adhesives compared to patients without denture. There was no significant difference in the mean duration in patients with adhesive type 1 compared to patients with adhesive type 2. There was a highly significant difference in the mean duration in patients with adhesive type 1 and adhesive type 2 compared to patients with adhesive type 3, which showed the lowest total mean duration value of the tested phonemes, both in initial and terminal-word positions.

Table (2): The total energy of the tested phonemes (/s/, /ş/, /z/, /ʃ/) in initial and terminal-word positions in patients; without dentures, with dentures without adhesive, and with three types of denture adhesives.

	Energy of initials in (dB)		Energy of terminals in (dB)	
Groups	Mean	SD	Mean	SD
Patients Without denture	54.28 [b]	3.44	45.11 [d]	4.21
Patients With denture (no adhesive)	46.73 [c]	4.12	40.61 [e]	3.38
Patients With denture With Adhesive type 1	57.90 [b]	3.21	50.43 [c]	4.12
Patients With denture With Adhesive type 2	61.65 [a]	2.89	54.76 [b]	3.86
Patients With denture With Adhesive type 3	63.33 [a]	3.69	57.21 [a]	4.18

Means with different letters are statistically significantly different according to Bonferroni's test ($P \leq 0.05$).

Adhesive type 1: (Super corega) which is based on Carboxymethyl cellulose (CC).

Adhesive type 2: (fittydent) which is based on Sodium Carboxymethyl cellulose and polyvinylacetate.

Adhesive type 3: (Fixodent) which is based on sodium Carboxymethyl cellulose and polymethylvinylether maleate.

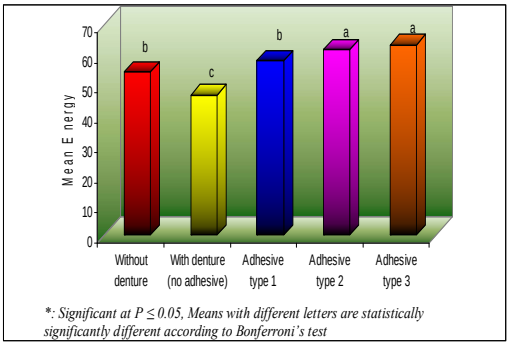

Figure (5), Energy of initials

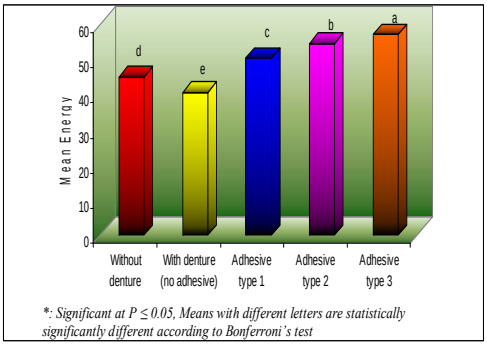

Figure (6), Energy of terminals

The results of the total energy of the acoustically tested phonemes (/s/, /ş/, /z/, /ʃ/) in initial and terminal -word positions, as shown in Table (2), figure(5,6) revealed that patients wearing dentures without adhesives showed the lowest mean energy value among the five groups, both in the initial and the terminal-word positions. A highly significant difference in the mean energy values was found in patients without denture compared to patients wearing dentures without adhesives. There was insignificant difference in the mean energy in patients without denture compared to patients wearing denture with adhesive type 1 in the initial-word position. There was a significant increase in the mean energy of phonemes in patients with adhesive type 2 compared to adhesive type 1, both in the initial and the terminal-word positions. There was a further significant increase in the mean energy in patients with adhesive type 3 compared to type 2 in the terminal -word position.

4. Discussion:

Perceptual Phonetic assessment of patients revealed that patients' articulation while they were edentulous was slightly deviated from normal, with defects in fricative phonemes (/s/, /ş/, /z/, /ʃ/), this may be attributed to a poor accommodation with the new situation. After wearing the denture without adhesives, there was a marked deterioration in the articulation. This is in accordance with Banknson and Byrne [18] who reported that loose dentures will not allow the tongue to function normally and this in turn will affect speech. This is also in agreement with Rothman [19] who clarified that pronunciation disturbance affecting fricative sounds could result from the direct influence of the artificial teeth and palate on the air flow as well as from different tongue positions and movements, as the tongue contacts specific parts of the teeth, alveolar ridge or the palate during each consonant pronunciation. Emily et al [20] clarified that consonant sounds are affected by the presence of poor retentive prosthetic appliance, and Ana Petrovic [21] found that unsatisfactory upper and lower dentures affect articulation markedly.

In the past, dentists used to think that the use of denture adhesives refers to poor dental skills as denture adhesives were thought as a solution for ill fitting denture [22,23]. Nowadays this philosophy was changed. The use of denture adhesives is highly recommended with patients seeking for extra retention demands that can't be achieved by the routine protocol of complete denture construction [24]. Denture retention and stability were significantly improved with the use of denture adhesives due to the bond created between the denture base and the underlying supporting tissues.[25]

Despite of the ability of the perceptual assessment to declare the improvement in the perceptually perceived phonemes in patients wearing dentures with adhesives than in those wearing dentures without adhesives, yet it couldn't differentiate the improvement between the different adhesive types. Therefore, acoustic assessment was performed as an objective assessment method for evaluating the most perceptually affected phonemes detected by the Arabic articulation test [17] which were the following fricatives; /s/, /ş/, /z/, /ʃ/, tested in initial and terminal- word positions.

Phonetic assessment for patients after applying adhesive type 1 revealed significant decrease in duration and significant increase in energy which reflected a better articulation, that may

be attributed to obvious improvement of lower denture retention as retention affects masticatory efficiency, phonation as well as self confidence as reported by Fujimori et al. [26]

Two hours after applying adhesive type 2(which combine both carboxy methylcellulose and polyvinylacetate), acoustic studies revealed that there was a significant decrease in the duration and a significant increase in the energy in comparison to adhesive type 1 (carboxy methylcellulose based type). This was in accordance with Panagiotouni et al [16] who concluded that fitty -dent denture adhesive gave a significant high scores on CC based adhesive type 1, when the degree of retention and retention duration were considered, due to the presence of polyvinylacetate adhesive material in combination with CC. This was almost the same results obtained by Berg et al [27] who declared that polyvinylaceteate works as a powerful adhesive material but it works only on dry surface so carboxy methylcellulose acts as a sponge and absorbs saliva. Acoustic assessment for fricatives /s/, / ş /, / z / and / ∫ / in initial and terminal- word positions, 2 hours after applying the third denture adhesive type (which combines both polymethylvinylether maleate plus Carboxymethylcellulose) revealed a significant decrease in duration and increase in energy, which improved the articulated phonemes, in comparison to adhesive type1 and type 2. This is because polymethylvinylether maleate is a durable powerful adhesive and Carboxymethylcellulose gives a rapid initial bond. This was in accordance with Psillakis et al [28] who tested Fixodent denture adhesive and concluded that using denture adhesive (fixodent) subjectively improves speech and chewing ability. This was also in accordance with Ozcan et al, [29] who clarified that bite force until denture dislodgement was increased for both old and new dentures after the use of denture adhesive based on polymethylvinylether maleate plus carboxymethyl cellulose (kukident) and this improvement lasted for 6 hours after application of the denture adhesives.

5. Conclusion:

This study clarified that the use of the denture adhesives markedly improves articulation in complete denture wearers as evidenced by both subjective and objective speech assessment, mainly due to their valuable effect on denture retention. The polymethylvinylether maleate-based adhesive Compound (Fixodent) gives the best results than Carboxymethyl cellulose-based denture adhesives (Supercorega) and Carboxymethyl cellulose plus Polyvinylacetate-based adhesive (fittydent) as evidenced by the improvement in the acoustic features of the tested Arabic phonemes.

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6. References:

1- Kuebker W: Denture problems: causes, diagnostic procedure and clinical treatment. Retention problems. J. Quintessence Int.1984,15; 131- 41.
2- Smith P and McCord J: What do patients expect from complete dentures? J. Dent. 2004, 32; 3-7.
3- Aghdaee N, Rostamkhani F and Ahmadi M: Complications of complete dentures made in Mashhad dental school. J. Mashhad dental school, 2007; 31: 1-3.
4- Raguse J and Gath H: A metabolically active dermal replacement (dermagraft) for vestibuloplasty. J. Oral Rehab. 2005 32; 337- 40.
5- Fukuda M, Takahanashi T and Lion M: Dentoalveolar reconstruction of a missing premaxilla using bone graft and endosteal implants. J. Oral rehab. 2003 30; 87-90.
6- Sekine J, Sano K, Ikeda H and Inokuchi T: Rehabilitation by means of osseointegrated implants in oral cancer patients with about four to six years follow up. J. Oral Rehab. 2006 33; 170- 4.
7- Marder M: Medical conditions affecting the success of dental implants. Compend Contin. Edu. Dent. 2004, 25; 739- 42.
8- Coats A: Usage of denture adhesives. J. Dent. 2000, 28; 137- 40.
9- Grasso J: Denture adhesives: changing attitudes. J. ADA. 1996, 127; 90- 6.
10- Wilson M, McCord J and Watts D: Denture adhesives- in vitro evaluation. J. Dent. Research. 1990, 969 -70.
11- Redford M, Dury T and Kingman A: Denture use and technical quality of dental Prosthesis among persons 18- 74: United States, 1988-1991. J. Dent. Res. 1996; 75; 714-25
12- Slaughter A, Katz R, and Grasso J: Professional attitudes toward denture adhesives:A Delphi Technique survey of academic prosthodontists. J. Prosthet. Dent. 1999, 82; 80-9.
13- Stafford D: Denture adhesives- a review of their uses and compositions. Dent. Pract. 1970, 21; 17- 9.
14- Yadav A and Yadav S: Denture adhesives- their stand in prosthodontics. J. Indian Prosthodont Soc 2005; 5; 62- 4.

15- Grasso J, Rendell J, and Gay T: Effect of denture adhesive on the retention and stability of maxillary dentures. J. Prosthet. Dent. 1994, 72; 399- 405.
16- Panagiotouni E, Pissiotis A, Kapari D, and Kaloyannides A: Retentive ability of various denture adhesive materials: An in vitro study. J. Prosthet. Dent. 1995, 73; 578-85.
17- Kotby M, Bassiouny S, Elzomor M and Mohsen E: Standardization of an articulation test. Proceedings of the 9th annual Ain Shams Medical Congress. 1986.
18- Banknson N and Byrne M: The relationship between missing teeth and selected consonants sound. J speech Hear Disorders. 1962, 27; 341-48.
19- William R and Joseph A: Diagnosis and treatment in Prosthodontics. 2nd ed. PSG. 1983 Publishing Co, Inc, Chap 1, 9-14
20- Tobey E and Finger I: Active versus Passive adaptation An acoustic study of vowels produced with and without Dentures J. Prosthet dent. 1983, 49; 314-20.
21- Petrovic A: The use of spectrograms for speech analysis in full denture wearers. J. Oral. Rehab.1974, 1; 353-60.
22- Heartwell C and Rahn A:Syllabus of complete dentures. 5th ed. Philadelphia: Lea and Febiger, 1986:104.
23- Benson D, Rothman R and Sims T: The effect of a denture adhesive on the oral mucosa and vertical dimension of complete denture patients. J. South Calif Dent. Assoc. 1972, 40; 468-73.
24- Batt C, Hof M, Zeghbroeck L, Ozcan M, and Kalk W: An international multicenter study on the effectivness of a denture adhesive in maxillary dentures using a disposable Gnathometers. Clin. Oral Invest. 2007, 11; 237- 43.
25- Adisman I: The use of denture adhesives as an aid to denture treatment. J. Prosthet. Dent. 1989, 62; 711-715.
26- Fujimori T, Hirano S, and HayaKawa L. Effects of a denture adhesive on masticatory functions for complete denture wearers. J. Med Dent Sci. 2002, 49; 151- 6
27- Berg E: A Clinical comparison of four denture adhesives. Int. J. Prosthodont. 1991, 4; 449-56.
28- Psillakis J, Wright R, Grbic J and Lamster I: In practice evaluation of a denture adhesive using a Gnathometer. J. Prosth. 2004, 13; 244-50.
29- Kulak Y, Ozcan M, and Arikan A: Subjective assessment by patients of the efficiency of two denture adhesive pastes. J. Prosthodontics. 2005, 14; 248- 52.

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