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Comparison of speech intelligibility, articulation and oromyofunctional behaviour in subjects with single-tooth implants, fixed implant prosthetics or conventional removable prostheses

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SUMMARY The purpose of this controlled study was to determine the impact of a single-tooth implant, fixed implant prosthesis and completely removable dental prosthesis on intelligibility, articulation and oromyofunctional behaviour. Additionally, the self-perceived overall satisfaction of the dental replacements and the effect on speech was questioned. Objective (acoustic analysis) as well as subjective assessment techniques (perceptual evaluation) were used. The satisfaction of single-tooth implant group was very high (100%) followed by a satisfaction of 87% for the fixed implant prosthesis group and 68% for the removable prosthesis group. The results of the phonetic analyses revealed a normal intelligibility and oromyofunctional behaviour in the three groups of dental replacements. Only one type of articulation disorders was observed in the single-tooth implant group, followed by three types of disorders in the removable prosthesis group and six types of disorders in the fixed implant prosthesis group. In this last group, not only 87% of the subjects showed distortions of one or more consonants but also most consonants of the Dutch language were disturbed in comparison with the single-tooth implant and removable prosthesis users. Special attention must be paid to the fricative /s/ because in more than 50% of all groups, this sound is disturbed.

KEYWORDS: single-tooth implant, fixed implant prosthesis, completely removable dental prosthesis, speech, oromyofunctional behavior, articulation

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Introduction

Any abnormality of the teeth or missing teeth could negatively affect the production of specific speech sounds. Along with the tongue, the teeth are directly involved in the production of /f/ and /v/ and help to produce the frication in sounds like /s/ and /z/ as the breath stream passes over the lower edges of the incisor teeth (1).

In case of loss of a single tooth, a removable prosthesis, a fixed tooth bone restoration (fixed bridge) or a single-tooth crown on a dental implant are means to restore function and aesthetics. Single-tooth implants are often recommended in dental health care because (i) preparation of adjacent teeth is avoided, (ii) they are the ideal replacement in spaced dentition, (iii) they are highly predictable, require little maintenance and (iv) they preserve ridge height and width (2). Recently, Dierens *et al.* (3) described a clinical implant survival rate above 90% after 16–23 years. The survival of fixed prostheses on natural teeth is described to be 66% after 20 years (4, 5). Hence, there is an international consensus that dental implants are the preferable treatment choice for single-tooth restoration

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(6). In completely or partially edentulous patients, the rehabilitation with fixed-implant-supported prostheses (FIP) or removable dentures is possible. The demand for FIP treatment has grown rapidly because of the increased expectation of a good quality of life, utility of the teeth (7) and aesthetics in the middle-aged and/or older population. When multiple teeth are lacking, the decision whether teeth or implants are chosen is guided by many factors including the condition of the teeth, cost-benefit analysis and the demand of the patient. It is well established that with complete, partial or single-tooth implant bone rehabilitation, the general comfort, aesthetics, chewing function and speech improve significantly (3, 8–10). Without any doubt, the gain of comfort and patient satisfaction is higher when fixed restorations are compared with removable appliances. Questionnaires studies reveal that patient experiences a significant improvement in function, comfort and quality of life when removable full dentures in either mandible or maxilla are replaced by implant rehabilitations. It was additionally revealed that phonetical problems were often encountered in 60% and 46% of the patients wearing removable dentures, respectively, in the maxilla or mandible (5).

The impact of single-tooth restoration on subjectively, patient assessed changes of speech characteristics and oromyofunctional behaviour was described by few authors. Vermylen *et al.* (11) questioned 48 patients treated with single implants, and general patient's satisfaction was excellent. None of the subjects experienced any speech problem related to the implant. Pjetursson *et al.* (12) questioned 104 patients with 214 single implants, and 91 indicated they had no problem with phonetics. Studies evaluating the speech in subjects with FIP show conflicting results. Lundqvist *et al.* (13) reported phonetic problems in 66% of the patients, especially for the /s/ and /z/ sounds, Jacobs *et al.* (14) found 84% of the patients with disordered speech especially for /s//z//d/ and /t/ sounds. According to Molly *et al.* (15), interdental phonation in the presurgical condition changed to addental articulation 12 months post-operative and sigmatism stridens changed into addental or interdental articulation 1 year after implantation while other authors (13–19) have not observed this phenomenon. Also the comparison between several studies (7, 13–19) is somewhat difficult, because different speech assessment techniques (questionnaires, perceptual evaluation, acoustic analysis) and different speech samples (counting, words and sentences) were used, and in most studies, no perceptual consensus evaluation by experienced speech language pathologists was performed. In addition only in the study of Jacobs *et al.* (14), an age- and gender-related control group was used.

The main purpose of this controlled study was to determine the impact of a single-tooth implant, fixed implant prosthesis and removable dental prosthesis on intelligibility, articulation and oromyofunctional behaviour after an appropriate adaptation period. Additionally, the perceived overall satisfaction of the dental replacement and the self-perceived effect on speech was also questioned. Moreover, gender-related differences regarding satisfaction were analysed. Based on literature data, phonetic disorders, especially of the /s/ sound and slightly impaired oromyofunctional behaviour, are hypothesised in all three types of dental treatment (especially in those replacing more than one natural tooth with either fixed or removable appliances). This information is important for dentists, orthodontists or stomatologists who treat professional speakers, i.e. clients for whom the smallest articulation problem may have career consequences or could hamper the practice of their profession. Given the growing demands of a perfect articulation in today's communication-based society and the lack of specialised speech analysis for Flemish speaking adults describing the impact of dental replacement on articulation and oromyofunctional behaviour, additional research is warranted.

Methods and materials

This study was approved by the human subject committee of the University Ghent.

Subjects

Fifty-three subjects participated in this study. Forty-four subjects with three different dental procedures (single-tooth implants, fixed implant prosthetics or removable dental prostheses) and nine subjects with correct dentition (control group) responded positively and participated in this study. The mean chronological age of these four groups did not differ significantly ($P < 0{\cdot}05$). This study included three groups of patients consecutively treated at the specialist clinic of the dental school of the Ghent University. They received, respectively, a single-implant restoration (SIR), a

10-unit fixed implant bone prosthesis (FIP) on four implants in the aesthetic zone of the maxilla or mandible or a new set of completely removable dentures (CRD) in both maxilla and mandible. All participants had hearing thresholds better than 20 dB in their poorer ear and agreed in the logopaedic assessment.

Single implant restoration group. Fourteen subjects (seven women and seven men) with a mean age of 48·0 years (range: 23·1–76·7 years) were randomly included after single-implant treatment in the aesthetic zone of the maxilla. They were adapted to their crown at least 1 year. All patients were treated by the same clinicians (F.R., P.C.), same surgeon (H.D.B), experienced in prosthetic treatment. The fluoride-modified titanium implants* were all installed in healed ridges and provided with a provisional crown immediately after implant insertion and replaced with a ceramic crown after 2 months.

Fixed implant prosthesis group. Fifteen subjects (nine women and six men) with a mean age of 48 years (range 43–75 years) and treated in a clinical study on implant survival using the all-on-four treatment (20, 21) concept agreed to participate in the logopaedic assessment 7·3 months (range 6–8 months) after FIP rehabilitation in the aesthetic zone of either mandible or maxilla. The all-on-four treatment is performed in completely edentulous maxilla or mandible and used to support a 10- to 12-unit fixed bridge (20, 21). The all-on-four concept is performed in heavily resorbed cases and advocates the placement of two anterior implants positioned straight on the dental arch but the two posterior implants are tilted to avoid the sinus. Surgery was performed by the same experienced surgeon (H.D.B.) under local anaesthesia, and all patients received four implants in the maxilla or mandible and a provisional fixed appliance of 10 teeth within one day after surgery. Given the fact that the surgery was flapless, there was no suturing of the soft tissues and minimal swelling occurred. The provisional restoration was replaced by a conventional final screw-retained jaw anchored bridge 3–4 months after initial treatment with 12 teeth.

Completely removable dentures group. Fifteen subjects (12 men and three women) with a mean age of 57 years (range 54–80 years) received a CRD and agreed to participate in the logopaedic assessment 1 year (range 0·11–1·2 years) after CRD placement.

Control group. For the comparison of articulation, the oromyofunctional behaviour and the acoustic characteristics of the /s/ sound, a control group of nine subjects with correct dentition and a mean age of 47·6 years (range: 22–61 years) was randomly assembled from the management of the department. These control subjects were selected based on the following criteria: none of the patients had a history of cleft palate, craniofacial deformities, deficiency or neuromotor dysfunction.

Methods

Objective as well as subjective assessment techniques were used to determine the speech characteristics (overall speech intelligibility and phonetic characteristics) and oromyofunctional behaviour (20, 22, 23). Speech assessments and oromyofunctional evaluations were performed 1·5 years (range 0·11–2·1 years) after the installation of the SIR, 7·3 months (range 6–8 months) after placement of the FIP and 1 year (range 0·11–1·2 years) after placement of CRD.

Impact of dental replacement on speech characteristics and overall satisfaction. One question (Did you experience any speech problem related to your implant) of the Dutch version of the Oral Health Impact Profile (OHIP-14) was used (24) to determine the impact of the prosthesis on speech. A high score (ranging from 0 to 4) implies a high impact of the prosthesis on the speech characteristics.

Subjects were also asked to rate overall satisfaction with their dental replacement (SIR, FIP, CRD) on a visual analogue scale (10 cm/100 points format) with 100% reflecting complete satisfaction and 0% corresponding to completely not satisfied.

Articulation and speech intelligibility. Speech samples for the assessment of articulation were elicited by means of a picture-naming test. This test requires subjects to name black and white drawings of common objects and actions. It elicits a speech sample containing instances of all Dutch single sounds, and most consonant clusters in all permissible syllable position (see Appendix) (24, 25). The samples were recorded digitally for further

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analysis in a sound-treated room of the speech department of the University Hospital of Ghent. The evaluation included a phonetic inventory and phonetic analysis. The phonetic inventory revealed which consonants and vowels the patient was capable of producing correctly in his/her native language. This analysis was conducted without making reference to the intended target sounds. A sound was considered to be present in the inventory when at least two instances of correct productions (i.e. consistent with the standard realisation of the sound) were found. In the relational analysis, consonant and vowel productions were compared with target productions and analysed for error types at the segment level.

The speech sample gathered by means of a picture-naming test was also used to judge overall speech intelligibility in words and sentences. An ordinal scale with four levels was used to rate speech intelligibility (0 = normal speech intelligibility, 1 = mildly impaired, 2 = moderately impaired and 3 = severely impaired speech intelligibility).

All analyses (for articulation and intelligibility) were based on a consensus narrow phonetic transcription made by two experienced speech language pathologists (P.M., E.V.K.) using the symbols and diacritics of the International Phonetic Alphabet. Both speech language pathologists were blinded to the subject's condition, i.e. whether a given subject belonged to the experimental or the control group. Moreover, the speech language pathologists first simultaneously and independently transcribed the samples before comparing transcriptions or intelligibility ratings aiming at a consensus. Only spontaneous and unequivocal naming of the stimulus picture were retained in the analysis. The speech samples thus gathered consisted of 135 different words.

Acoustic analysis. A digital sample of the /s/ sound was recorded from the experimental and the control group, using the CSL apparatus (26). The signals were sampled at 44 100 Hz. Subsequently, each sample was visualised by means of Praat software (27). The cursor was placed manually halfway the visible frication and a 1-s section was extracted from each /s/ token using a Hamming window. A Praat script was developed to derive spectral characteristics, i.e. the spectral moments (centre of gravity, standard deviation, skewness and kurtosis) and the peak frequency value of the Fast Fourier spectrum. The centre of gravity is a measure of the average height of the frequencies in the spectrum, and the standard deviation quantifies their dispersion around the centre of gravity. The skewness is a measure for the difference between the shape of the spectrum above and below the average frequency value, and the kurtosis shows how much the shape of the spectrum differs from a Gaussian distribution. These parameters quantify spectral details that correspond to the frequency of fricative speech sounds and to their articulatory distinctivity.

Oromyofunctional assessment. During oromyofunctional assessments, five functions were measured as proposed in the protocol of Lembrechts *et al.* (28). These functions were lip function (lip position at rest, lip closure, dispersion of the corners of the mouth, lip protrusion, lip strength, lip position during swallowing), tongue function (tongue position at rest, tongue protrusion, tongue retraction, tongue lifting against the upper lip, tongue lifting against the lower lip, lateral movements of the tongue, tongue position during swallowing), blowing, sucking and swallowing. A three-point rating scale was used (0 = normal function, 1 = decreased function, 2 = function impossible). The presence of the following oromyofunctional disorders was verified: presence of sucking habits, slavering, mouth breathing, lip incompetence and bruxism. The chewing function was not tested. The experienced speech pathologists (P.M., E.V.K.) first rated independently. In case of disagreement, the samples were replayed and discussed until a consensus was reached.

Statistical analysis

For the comparison between the overall satisfaction and the impact on speech, the Mann–Whitney *U*-test was performed. Several Kruskal–Wallis tests were performed on the five acoustic parameters (four spectral moments i.e. centre of gravity, standard deviation, skewness and kurtosis as well as the peak frequency value of the Fast Fourier spectrum). First, the contrasts between sibilants in the speech of the SIR users, the FIP users, the CRD users and the norm speakers were evaluated. Kruskal–Wallis tests were also performed to compare acoustic results from participants who produced a sigmatism and all other patients who, according to the panel of listeners, produced a normal /s/ sound, i.e. comparison of all deviant and all normal sounding /s/ productions. *Post hoc* comparisons were performed using Mann–Whitney *U*-tests.

Results

Impact of dental replacement (SIR, FIP and CRD group) on speech characteristics and overall satisfaction

The overall satisfaction with the SIR ranged from 100% (n = 7) to 80% (n = 1) with a mean value of 95%. The overall satisfaction with the FIP ranged from 50% (n = 1) to 100% (n = 4) with a mean value of 87% and for the CRD group from 20% (n = 1) to 100% (n = 2) with a mean value of 68%. The overall satisfaction in the control group was 100% (n = 9). The Mann–Whitney U-test revealed that the patients of the SIR group were significantly more satisfied ($P < 0{\cdot}01$) in comparison with the CRD. No other significant differences were found regarding the overall satisfaction between the FIP and SIR. No gender-related differences were obtained.

On the question regarding satisfaction with phonetics (question 1 of the OHIP), 0% of the control group (n = 9), 0% of the SIR users (n = 14), 53% (n = 8) of the FIP subjects and 33% (5/15) of the CRD subjects mentioned problems with speech after placement. According to these subjects speech problems were effectively related to their dental treatment. The Mann–Whitney U-test revealed a significant difference between the satisfaction with phonetics of the SIR, the CRD group ($P = 0{\cdot}03$) and the FIP subjects ($P < 0{\cdot}01$).

Articulation, speech intelligibility and oromyofunctional disorders

All the subjects of the SIR group, the FIP, the CRD group and the control group had a normal speech intelligibility (consensus evaluation 100%).

The phonetic inventories showed that all subjects (SIR, FIP, CRD and the control group) were capable of producing all Dutch vowels and consonants. A sound was considered to be present in a subject's inventory when at least two instances of correct production of the sound were found. None of the subjects showed a distortion of the vowels or semi-vowels. The total percentage of subjects presented with one or more distortions of the consonants was 57% (8/14) for the SIR users (100% consensus evaluation), 87% (13/15) for the FIP group (100% consensus evaluation) and 60% (9/15) for the CRD group (98% consensus evaluation). In the control group, the phonetic characteristics were normal (100% consensus evaluation). Significantly ($P = 0{\cdot}02$) more subjects with FIP produced a phonetic disorder in comparison with both the SIR, the CDR group and the control group.

An overview of the phonetic distortions in the subjects with dental replacement is presented in Table 1. Oromyofunctional behaviour in all groups was observed as normal. Only in one subject of the FIP group, one subject had restrictions regarding the dispersion of the corners of the mouth (consensus 100%).

Acoustic analysis

The Kruskal–Wallis test on the five acoustic parameters across the four categories of participants revealed no significant differences except for the second spectral moment, i.e. the standard deviation of frequencies in the Fast Fourier spectrum ($P < 0{\cdot}05$). The mean values of this parameter are shown in Table 2. *Post hoc* Mann–Whitney U-test comparisons made clear that the FIP and CRD results significantly differ from the norm speakers' results ($P < 0{\cdot}05$). Also, FIP results differ significantly from the SIR users' results ($P < 0{\cdot}05$). The Kruskal–Wallis test on all acoustic parameters from the /s/ sounds produced by patients perceived as having a sigmatism (SIR group : n = 8, FIP group: n = 12, CRD group: n = 8) versus those perceived as producing a normal /s/ again revealed no significant differences except for the second spectral moment ($P < 0{\cdot}05$). In Fig. 1, respectively, Fig. 2, the sample outcome of the spectral analyses of the [s] sound articulated by a subject of the control group and a subject with a SIR is provided. In Fig. 1, the spectral moments were 9629 Hz (centre of gravity), 1685 Hz (standard deviation), −0·29 (skewness) and 3·07 (kurtosis). In cases of sigmatism, the standard deviation was significantly higher, i.e. the dispersion of energy over the frequency continuum was larger as shown in Fig. 2. In Fig. 2, the spectral moments were 7170 Hz (centre of gravity), 2992 Hz (standard deviation), 0·46 (skewness) and −0·49 (kurtosis). Typically, the standard deviation is higher than the value in Fig. 1.

Discussion

The present detailed controlled study compared the impact of three types of dental replacements namely SIR, FIP and CRD on both speech intelligibility, articulation (perceptual and acoustic analysis) and

Table 1. Overview of the phonetic disorders and descriptions (1) in patients with single-tooth implants (SIR), fixed implant prosthetics (FIP) and removable dental prostheses (CRD). The number of subjects (*n*) presented with a phonetic disorder is shown between brackets

Speech sound	Phonetic disorder	Percentage (*n*)	Comment
SIR group			
/s/	Sigmatism stridens	57 (8/14)	/s/ sound accompanied with a whistle sound
	Sigmatism simplex	75 (6/8)	/s/ sound without sufficient frication
		25 (2/8)	
FIP group			
/s/	Sigmatism simplex	80 (12/15)	/s/ sound without sufficient frication
	Sigmatism stridens	40 (6/15)	/s/ sound accompanied with a whistle sound
	Sigmatism addentalis	33 (5/15)	/s/ sound with the tongue tip against the central incisors
		7 (1/15)	(instead of against the upper alveolus)
/z/	Simplex /z/	27 (4/15)	/z/ without sufficient frication
ʃ (sj)	Without sufficient frication	20 (3/15)	/ʃ/ without sufficient frication
ʒ (zj)	Without sufficient frication	20 (3/15)	/ʒ/ without sufficient frication
/t/	Addental production	33 (5/15)	/t/ with the tongue tip against the incisors
	/t/ followed by a slight /s/	20 (3/15)	(instead of against the upper alveolus)
		13 (2/15)	/t/ followed by a slight production of the fricative /s/ showing an over articulation
/d/	Addental production	27 (4/15)	Production of the /d/ with the tongue tip against the
	Devoiced /d/	20 (3/15)	central incisors (instead of against the upper alveolus).
		7 (1)	production of the /d/ without vocal fold vibration
CRD group			
/s/	Sigmatism stridens	53 (8/15)	/s/ sound accompanied with a whistle sound
/z/	Simplex /z/	27 (4/15)	/z/ without sufficient frication
/t/	/t/ followed by a slight /s/ sound	27 (4/15)	/t/ followed by a slight production of the fricative /s/

Table 2. Standard deviation (Hz) of frequencies in the Fast Fourier spectrum of /s/ of the single-tooth implant (SIR) group, the fixed implant prosthetics (FIP) and removable dental prostheses (CRD) group and the control group

SIR group	FIP group	CDR group	Control group
2362	3306	2701	2081

oromyofunctional behaviour. Additionally, the perceived overall satisfaction of the dental replacement and the self-perceived effect on speech was questioned.

The mean overall satisfaction of the SIR group was very high (100%) and has the same overall satisfaction as the control group, followed by an overall satisfaction of 87% for the FIP. Taking into account the aspect of ''removable'' dental elements, a comprehensible significantly higher satisfaction of the SIR group in comparison with the CRD (68%) was obtained. The gender-related satisfaction also measured with a visual analogue scale (females rate their overall satisfaction significantly higher than the males) as described in the study of Awad and Feine (29) could not be found in this study. Hypothetically, one can assume that differences in age (range 35–65 years in the study of Awad and Feine (29) versus 23–80 years in this study), type of prostheses (mandibular prostheses versus SIR and FIP in this study) and other factors like previous edentulous periods, appearance and functionality of the dental replacements and counselling could play a role. These different aspects of satisfaction were not addressed and could be seen as a limitation of this study. Regarding the self-perceived satisfaction with phonetics, significantly more subjects with FIP and CRD mentioned speech problems related to their dental treatment in comparison with the SIR and the control group. This finding in this study is in agreement with the report of Vermeylen *et al.* (11) and Pjeturson *et al.* (12). In most SIR users, the implant can be installed in proper position, because bone resorption and crestal changes are limited. Possible misplacement out of the direction of the dental arch inflicting problems with correct tongue position and consequently phonetics can be easily avoided. These above-mentioned self-perceived findings are totally in agreement with the results of the consensus phonetic analyses.

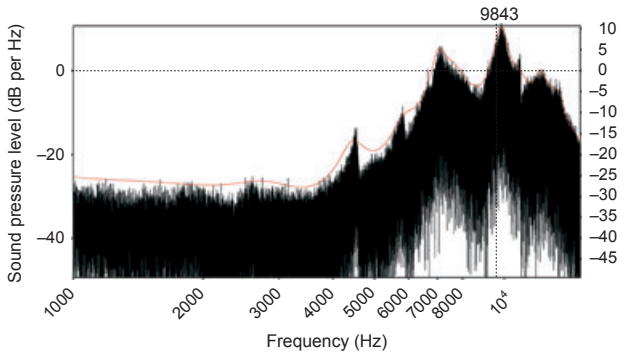

Fig. 1. Sample outcome of the spectral analyses of the [s] sound articulated by the subjects of the control group. In this example, the spectral moments were 9629 Hz (centre of gravity), 1685 Hz (standard deviation), −0·29 (skewness) and 3·07 (kurtosis). In cases of sigmatism, the standard deviation was significantly higher, i.e. the dispersion of energy over the frequency continuum was larger (see Fig. 2.).

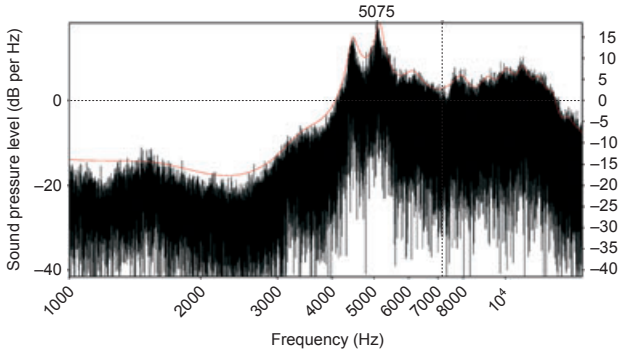

Fig. 2. Sample outcome of the spectral analyses of the [s] sound articulated by one of the subjects with a SIR. In this example, the spectral moments were 7170 Hz (centre of gravity), 2992 Hz (standard deviation), 0·46 (skewness) and −0·49 (kurtosis). Typically, the standard deviation is higher than the value in Fig. 1.

The results of the phonetic analyses showed that only one type of articulation disorders was observed in the SIR group, followed by three types of articulation disorders in the CRD group and six types of disorders in the FIP group. In the FIP group, not only 87% (13/15) of the subjects showed distortions of one or more consonants but most consonants of the Dutch language (27%, 6/22) were disturbed in comparison with the CRD (14%, 3/22) and the SIR (5%, 1/22) group. The alveolar fricative /s/ was disturbed in more than 50% of both the SIR, FIP and CRD group. As hypothesised, the /s/ is a vulnerable sound because the teeth are significantly involved in the production of the /s/ and after linguo alveolar contact and narrow air blade the airstream is directed over the upper or lower incisors (1). Both the paradontologist and speech language pathologist must be aware of the persistency (even one year after placement) of a sigmatism stridens or simplex in these subjects. Also the alveolar fricative /z/, the prepalatal fricatives /ʃ/ and /ʒ/ (produced with insufficient frication) and the alveolar explosives /t/ and /d/ (produced with addental production) are vulnerable sounds and are disturbed especially in the FIP group without disturbing the overall speech intelligibility. The nature of these phonetic errors was not the purpose and cannot be explained from this study. The use of palatography during the production of these vulnerable sounds in isolated position or specific words may specify the tongue-alveolar ridge relationship and is subject for further research. Another study design using a prospective cohort approach with more appropriate baseline measurements will be used. Acoustic analysis points to the second spectral moment of sibilants, i.e. the dispersion of energy around the centre of gravity in the noise spectrum, as an objective index for evaluation and follow-up of articulation. The spectral content of sibilants is a function of place, degree, and length of the articulatory constriction in the anterior oral cavity. According to the present analyses, only SIR users approach normality, while FIP results are at the other end of the continuum. Subjective evaluation (sigmatism or not) only roughly correlates with these results from acoustic analysis. The drawback of subjective evaluation, however, usually lies in the instruction of the raters and the consistency of their ratings. Whether the different timing in speech assessments after dental replacement could influence the speech characteristics is subject for further research.

In conclusion, the results of the detailed analyses revealed a normal speech intelligibility and normal oromyofunctional behaviour in the three groups of dental replacements. Especially, the SIR group reported a high self-perceived satisfaction with both their dental replacement and speech. These self-perceived findings were in agreement with the consensus perceptual evaluation and the results of the acoustic analysis. Only one type of articulation disorders was observed in the SIR group, followed by three types of articulation disorders in the CRD group and six types of disorders in the FIP group. Special attention must be paid to the alveolar fricative /s/ because in more than 50% of all groups, this sound is disturbed. To what extent a

motor-oriented speech therapy immediately post-dental replacement with focus on the tongue function and the production of a sufficient tongue groove and frication of the airstream during the production of the /s/ will decrease the persistent phonetic disorder is subject for further research in a large number of subjects.

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Appendix: speech stimuli

boom	vinger	huis	fles	citroen	sleutel
appel	groot	giraf	slang	neus	vogel
zeven	ballon	hond	acht	tas	klok
kerk	tafel	deur	auto	wieg	geld
doos	ezel	bloem	boekentas	zon	geweer
trompet	kabouter	vlag	suiker	hamer	voet
garage	olifant	nest	tent	scheerapparaat	gordijn
radio	kado	strijkijzer	hoed	molen	
oranje	kruis	rood	koffiekan	muts	groen
wortels	trommel	worst	spons	twee	pruim
sneeuwman	tandenborstel	brief	mes	fiets	boom
wiel	zetel	appel	gieter	stoel	vissen
arm	net	brievenbus	bank	kasteel	trein
vis	gitaar	drie	frieten	paddestoel	nacht
ster	kaars	televisie	kam	lepel	das
hoofd	één	chocolade	zwart	potlood	piano
kapstok	knoop	boek	jongen	bal	wolk
banaan	toilet	knie	blauw	kameel	paraplu
paard	borstel	schaar	peer	glas	vlinder
meisje	lamp	muur	sigaret	bril	schrijven
vliegtuig	zwaan	telefoon	trap	leeg	pluim
soldaat	stofzuiger	uurwerk	kraan	kooi	lachen
hemd	varken	fototoestel	zaag	soep	schilderi