

The Effects of Increasing Occlusal Vertical Dimension among Edentulous Jordanian Patients

An Original Article

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Abstract: *Increasing the Vertical Dimension of Occlusion is usually done using removable dentures or an implant fixed prosthesis in edentulous patients. There is no consensus between researchers whether these potential negative consequences of increasing the Vertical Dimension of Occlusion. Most of the previous studies on Vertical Dimension of Occlusion were conducted on dentulous subjects in developed countries. This study aims to assess the effects of increasing Vertical Dimension of Occlusion on edentulous patients in the dental clinics at the Royal Medical Services of Jordan. Fifty patients between the age of 41 and 82 years participated in this cross-sectional study. Seven out of ten participants complained of temporomandibular joint pain, soreness under complete removable dentures was reported by 80.0% of the participants and difficulty in speech was noticed in 64.0% of the participants. Although increasing the Vertical Dimension of Occlusion is a common functional and aesthetic prosthetic dental procedure, it is still associated with frequent side effects after one-month follow-up. Informing the patients about the possibility of these side effects would help them make an informed decision before increasing their Vertical Dimension of Occlusion. Future research is needed to examine the long-term effects of increasing the Vertical Dimension of Occlusion in edentulous patients.*

Keywords: Occlusal Vertical Dimension, Temporomandibular Disorder, Oral rehabilitation, Edentulous, The Royal Medical Services of Jordan

1. Introduction

Scientists started to observe the effects of altering Vertical Dimension of Occlusion (VDO) on human and animal subjects in the early 20th century and this is still a matter of ongoing debate and investigation [1], [2]. Abduo and Lyons define the VDO in dentulous subjects as the vertical dimension of the face when the mandibular and maxillary teeth are in centric occlusion [3].

Several clinical and aesthetic indications for altering the Vertical Dimension (VD) were reported in the literature [4]–[6]. Obviously, these indications vary a lot between dentulous and edentulous patients. For example, Wassell et al. stated that the main indications for increasing VDO in dentulous patients are to create a space for restorative material or to allow for a space to correct poorly placed or previously executed rehabilitation [1], [4]. Meanwhile, Ormianer and Palty reported restoring facial anatomical harmony and some other aesthetic features as indications for increasing VDO in edentulous patients [7]. On the other hand, increasing the VDO to treat temporomandibular joint (TMJ) disorders remains as one of the main controversial indications to increase VDO [8]–[10].

In edentulous patients, increasing the VDO is usually done using complete removable dentures or by an implant fixed prosthesis [7], [11]. There are several recommendations about the acceptable range for increasing the VDO. However, in general, most resources agreed that increasing the VDO up to five millimeters in dentulous patients is an acceptable and safe range [12]–[15].

2. Literature Survey

Alteration of VDO is usually associated with a short-term and long-term body adaptation period. The adaptation might

include changes in bite power and in the masticatory system [2], [16], [17]. However, there are some case reports regarding dentulous patients who could not tolerate alteration in their VDO. Nevertheless, it is hard to know if this intolerance was a consequence of the alteration in the VDO or due to other processes of the dental reconstructive interventions [18], [19].

In addition, there are several theories about age effects on VDO. Some researchers consider the VDO as a fixed dimension that does not change at all through life, while others consider it as a dynamic dimension that could be altered when there is a justification for this alteration [20], [21]. The current evidence-based literature favors more the later theory that it is possible or even advisable to alter the VDO gradually when there is a clinical or aesthetic indication, keeping in mind that there are also some reported contraindications for altering the VDO, such as Costen Syndrome [1], [8].

Similar to almost all other prosthodontics procedures, there are some potential side effects for increasing the VDO. Bloom and Padayachy reported speech difficulties, especially with the pronunciation of the letter ‘S’ and muscular or joints pain, as potential negative consequences for altering the VDO [22]. At the same time, Najjar et al. reported elongated face syndrome, fatigue facial expression and swallowing disorders as potential negative consequences for increasing the VDO [23]. Meanwhile, other studies have shown that headaches, mouth clicks, teeth grinding, chewing disorders and restoration failures as a possible side effect of altering the VDO [4], [14], [24], [25].

Currently, there is no consensus between researchers whether these potential negative consequences of increasing the VDO are transient or permanent consequences and there are some contradicting reports about the needed follow-up period until patients possibly adapt to the newly established

VDO [14], [19], [26].

In general, researchers are using three main methods to assess the effects of VDO alteration. In fact, researchers usually use a combination of these assessment methods to capture all possible effects of VDO alteration [18], [27]. The frequently described assessment methods are subjective symptoms assessment, phonetic assessment and facial electromyography (EMG) examination [14], [20], [28].

Most of the previous studies on VDO were conducted on dentulous subjects in developed countries with almost no representation of Middle Eastern subjects [1], [29]–[31]. This study aims to assess the effects of increasing VDO on a group of randomly selected edentulous Jordanian patients. The objective of this study is to examine the safety of this prosthodontics procedure on Jordanian subjects and to help the dentists and patients to make an informed decision about the expected benefits and risks of increasing VDO.

3. Methods

The ethical committee of the Royal Medical Services (RMS) of Jordan approved this study. This cross-sectional study was carried out in accordance with the Helsinki Declaration and the Royal Medical Services regulation to protect human research participants [32]. After explaining this study's aim, the authors obtained voluntary written informed consent from all participants. Adult edentulous patients who regularly use complete removable dentures that have led to an increase in their VDO were eligible for inclusion in this study. Exclusion criteria were congenital facial anomalies and patients with an unstable medical condition.

The primary researcher reviewed the electronic medical records of RMS dental clinics and randomly selected and invited eligible edentulous patients through a phone call. Patients who received complete removable dentures were invited to participate in the study after 30 days of regular prosthesis use. Demographic and clinical data were collected from the medical records. Subjective symptoms were collected using a written questionnaire (Table 1). The questionnaire included a pain assessment section and a question about the clicks. Through the physical examination, the researcher documented fatigue expression signs.

Table 1: Study questionnaire

Patient number	
Gender	Male
	Female
Age in years	
Sing and symptoms 30 days after increasing VDO	Temporomandibular joint pain
	Soreness in the oral mucosa under the denture
	Fatigue facial expression
	Difficulty in speech

While the patient is in the upright position, they were asked to wear their currently used complete removable dentures, and then the patient was asked to close the dentures all the way until the teeth touch. The primary researcher conducted a phonetic assessment for eligible patients who agreed to participate in this study. The patient was asked to repeat a word with an 'S' sound to assess the phonetic effects of

increasing the VDO [1]. The VDO was considered increased when the close speaking space equals zero.

To allow for an adequate adaptation period, all assessments were conducted after at least 30 days of increasing the VDO [22]. Data were collected in January 2021 at the dental clinics of King Talal Medical Hospital (KTMH), Al Mafraq-Jordan.

Data was first recorded on paper forms and then entered into an Excel Sheet (Microsoft Corp., Redmond, WA, USA), where it was reviewed and cleaned. Then, the collected data were analyzed using Statistical Package for the Social Sciences (SPSS) (IBM Corporation, version 25.0, USA). Spearman correlation coefficient was used to calculate the correlation between study variables. A p-value < 0.05 was considered statistically significant.

4. Results & Discussion

In total, 50 edentulous patients met the inclusion criteria of the current study and consented to participate in it. Half of selected participants were females and the other half were male patients. The mean age of study participants was 62.6 ±12.0 years, ranging between 41 and 82 years. The sociodemographic characteristics of current study participants are described in table 2.

Table 2: Characteristics of study participants

Variable	Mean	Standard Deviation
Age (in years)	62.6	12.0
	n	%
	40 - 49	18
	50 - 59	26
	60 - 69	24
	70+	32
Gender	Male	50
	Female	50

It was observed that all study participants have elongated face syndrome. Moreover, 70.0% of the participants complained of temporomandibular joint (TMJ) pain after increasing the VDO. Soreness under the complete removable dentures was reported by 80.0% of the participants. In addition, signs of facial fatigue was observed in almost half of the patients. By the phonetic examination, difficulty in speaking the 'S' sound was noticed in 64.0% of the participants. Edentulous patients' signs and symptoms 30 days post increasing their VDO are described in table 3.

In addition, patients' gender was significantly associated with reporting soreness underneath the denture. Around two-thirds of male patients reported soreness compared with 96.0% of female patients and this difference was statistically significant (p-value 0.005). On the other hand, no significant differences between the two genders were observed in the remaining signs and symptoms of increased VDO. The distribution of study subjects according to their gender and the presence of signs and symptoms 30 days after increasing the VDO is demonstrated in table 4.

Table 3: Subjective and objective effects of increasing VDO

Variable	Yes		No	
	n	%	n	%
Temporomandibular joint pain	35	70.0	15	30.0
Soreness in the oral mucosa under denture	40	80.0	10	20.0
Fatigue facial expression	23	46.0	27	54.0
Difficulty in speech	32	64.0	18	36.0

Table 4: Comparison of subjective signs and symptoms according to gender (n=50)

Variable	Female (n=25)		Male (n=25)		P-value
	n	%	n	%	
Temporomandibular joint pain	16	64.0	19	76.0	0.355
Soreness in the oral mucosa under denture	24	96.0	16	64.0	0.005*
Fatigue facial expression	14	56.0	9	36.0	0.156
Difficulty in speech	14	56.0	18	72.0	0.239

* Significant p-value

Furthermore, it was observed that there is a statistically significant correlation between the difficulty of speech and fatigue facial expression 30 days after increasing the VDO (p-value <0.001). Meanwhile, no significant correlation was detected between patients' age and signs or symptoms of increased VDO. Table 5 illustrates the correlation between age, signs and symptoms of increased VDO.

The presence of signs and symptoms post increasing VDO in the current study is in line with some previous studies. For example, Bloom and Padayachy reported that speech problems especially with pronouncing the letter 'S' as a common issue post alteration of the vertical dimension [22, p. 1]. Similarly, Gittelson reported pain and joint instability as side effects for increasing the VDO [19]. In addition, a study by Wassell et al. showed that three-quarters of patients with altered VDO would suffer of pain or clicks specially in the initial phase of treatment, but their symptoms might improve after an adaptation period to the new VDO [4].

Contrary to the current study findings, Dahl and Krogstad's study showed no pain side effects after altering the VDO. However, Dahl and Krogstad's study involved only dentulous patients and this difference in study population could explain the differences in studies outcomes [16]. In addition, a literature review by Moreno-Hay and Okeson concluded that increasing the VDO will not have an effect on the temporomandibular joint pain. However, most of included studies in Moreno-Hay and Okeson literature review were also conducted on dentulous patients [14]. In addition, another study concluded that all signs and symptoms associated with increasing the VDO were transient and self-limited after a month to three of adaptation to the new VDO [3], [33]. The long-term effects of altering the VDO are beyond the current study's scope, but it seems an interesting research area for future studies especially in edentulous patients. Meanwhile, Krishna et al. reported that increasing the VDO in dentulous patients is a well-tolerated process but it needs to be limited to a maximum increase of 3 to 5 millimeters [34]. Similar to other studies on edentulous patients, the extent of increasing the VDO was mostly dependent on the phonetic testing, therefore, it is not possible to assess the association between levels of

increasing the VDO and patients' signs and symptoms [1], [7], [35].

According to the current study findings, the female gender was associated with increased soreness underneath the prosthesis 30 days after increasing the VDO. This result is comparable to several other previous researches that associated female gender with reported oral soreness after using a dental prosthesis [36]–[38]. However, this association between gender and oral soreness could be possibly related to the process of dental rehabilitation and the findings of the current study are not sufficient to examine the association between increasing the VDO and oral soreness underneath the denture in female patients.

Moreover, according to the current study results, there is a significant correlation between facial fatigue expression and speech difficulty. Solomon's literature reviews identified a similar association between fatigue facial expression and difficulty in speech and swallowing [39], [40].

The main limitations of the current study are the relatively small sample size from a single center that limits the generalization of study results. Also, comparable to all cross-sectional studies, the causality cannot be identified by this research methodology. Finally, due to having interviewer-administered questionnaire, the interviewer bias cannot be totally eliminated. However, prior to the data collection phase, all researchers were trained on proper interview techniques to minimize the effects of interviewer bias.

The main strengths points of the current study are being one of the handful studies that examined the effects of increasing VDO on edentulous patients, while most of the previous studies studied this topic on dentulous or partial dentulous patients [4], [21], [41]. Moreover, including subjective and objective assessment methods of patients' signs and symptoms is another strength point for the current study.

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Table 5: Correlation between subjects' characteristics and effects of increasing the VDO

		Age	TMJ pain	Soreness in the oral mucosa	Fatigue facial express	Difficulty in speech
Age	CC*	1.000	0.012	-0.017	0.248	-0.126
	P-value		0.934	0.905	0.083	0.385
TMJ pain	CC*	0.012	1.000	0.109	0.254	-0.218
	P-value	0.934		0.451	0.075	0.128
Soreness in the oral mucosa	CC*	-0.017	0.109	1.000	0.161	-0.063
	P-value	0.905	0.451		0.265	0.666
Fatigue facial express	CC*	0.248	0.254	0.161	1.000	-0.729**
	P-value	0.083	0.075	0.265		<0.001
Diff. in speech	CC*	-0.126	-0.218	-0.063	-0.729**	1.000
	P-value	0.385	0.128	0.666	<0.001	

* CC is Correlation Coefficient.

** Spearman's correlation is significant at the 0.01 level (2-tailed).

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5. Conclusion

Although increasing the VDO in edentulous patients is a common functional and aesthetic prosthetic dental procedure, it is still associated with frequent side effects such as pain and difficulty in speech at one month benchmark of follow-up. Informing the patients about the possibility of these side effects would help them making an informed decision before increasing their VDO. Proper patient-centered dental counseling and pain management would help the patient during their adaptation period for the new VDO. Future research is needed to examine the long-term effects of increasing the VDO in edentulous patients.

6. Future Scope

The current study identified several common side effects for increasing the VDO in edentulous patients. However, there is no agreement between researchers whether these side effects are permanent and cannot be tolerated by patients or transient and self-limiting after a certain adaptation period [1], [3], [16]. Researchers are encouraged to conduct future long-term studies on this matter with a special focus on edentulous patients. In addition, the best management approach for VDO side effects is another needed

interventional research area in order to identify the best evidence-based protocols to control or prevent the side effects that may develop post increasing the VDO in edentulous patients.

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