Abstract
The aim of this study is to evaluate the impact of anatomical, prosthetic features and implant location on quality of life (QoL) after treatment with locator-retained mandibular overdentures. Thirty patients with locator-retained mandibular overdentures were included in this study. The study examined the following: (1) demographic characteristics, (2) intraoral measurements, (2a) the age of the prosthesis, (2b) the distance between the implants, (2c) the distance between the alveolar crest and the hypothetical line that crosses two implants (2d) the crest section, (2e) tissue quality, (2f) the arc form, (3) measurements of the prosthesis, (3a) freeway space, (3b) the distance between the canines, (3c) the top of the canine/the distance between the distal teeth of the second molar tooth, (3d) the canine/molar angle, and (3e) the arc form saved. After the measurements were made, patients were asked to mark the V AS (100 mm) scale to indicate their satisfaction with their prosthesis and to complete the OHIP-14 questionnaire. A multivariate linear regression analysis was performed using OHIP-14 and VAS variables. The multivariate linear regression analysis showed gender and the distance between the alveolar crest and the hypothetical line that crosses two implants (2c) as the most important factor affecting anatomic, prosthetic features and implant location on QoL (p <0.05). The satisfaction of patients using mandibular overdenture prosthesis may vary depending on many factors. According to this study, the implants should be positioned on the same linear line and at the most distant position for patient satisfaction.

Keywords: Overdenture, implant, quality of life, satisfaction
aesthetic-related quality of life (OARQoL), and quality of life associated with dental aesthetic satisfaction (QoLDAS-9) [22].

Prosthodontics research has mainly revolved around the QoL of completely edentulous patients whose oral health and functions have been restored with implant-retained overdentures. The satisfaction of patients using mandibular overdenture prosthesis may vary depending on many factors. However, it is not clear in the literature which factor most impacts their QoL. The aim of this study was to evaluate the impact of prosthetic and anatomical features on the QoL for individuals with locator-retained mandibular overdentures. The null hypotheses tested were that 1) oral anatomy, 2) prosthesis features and 3) implant location have no impact on QoL.

Material and Methods

The present study is a retrospective analysis on 30 patients (9 male, 21 female; 44-83 years old, Figure 1) whose implant supported prosthetic restorations were conducted in the Department of Prosthodontics, Inonu University. The experimental protocol was approved based on the ethical standards of the Declaration of Helsinki. Prior to the study, the approval was obtained from the Ethics Committee of Inonu University. (20/11/2018)

The following measurements were recorded:

1. Demographic characteristics

2. Intraoral measurements
   a. The age of the prosthesis
   b. The distance between the implants (linear, millimeter)
   c. The distance between the alveolar crest and the hypothetical line that crosses two implants
   d. Crest section (round/retentive/sharp/irregular)
   e. Tissue quality (firm /hyperplastic/mobile)
   f. Arc form (square/oval/triangle)

3. Measurements of the prosthesis
   a. Freeway space
   b. The distance between the canines (millimeter)
   c. Canine/molar angle
e. Arc form (square/oval /triangle)

The volunteers then answered the OHIP-14 questionnaire. After the measurements were made, patients were asked to mark the VAS (100 mm) scale to indicate their satisfaction with their prostheses. The OHIP is a validated and reliable questionnaire that includes 7 base problems such as functional limitation, pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap [6,23]. All items were scored on a Likert scale ranging from 0 (very positive) to 4 (very negative) that were summed to calculate an overall score ranging from 56 showed the maximum negative score, to 0 a perfect QoL appreciation. The volunteers’ responses were scored as very often, 4; fairly often, 3; occasionally, 2; hardly ever, 1 and never, 0.

Analyses were performed with statistical software (IBM SPSS Statistics v23.0; IBM Corp). The relationship among implant location, oral anatomy, prosthesis features and QoL was investigated, and a stepwise multivariate linear regression was conducted. The statistical analyses were performed with the significance level set at p values of 0.05

Result

This study included 30 patients with a mean age of 62 that 21 were females with a mean age of 59 years, and nine were males with a mean age of 66 years. The average OHIP score of females was 7.1 and 3.6 for males. The averages of VAS scores were 79.2 % and 86.5 % respectively for females and males. The age of the prosthesis was found to be close to the average values for females (23.5 months) and males (22 months). The QoL with OHIP mean score was used as a dependent variable, whereas age, gender, age of the prosthesis, the distance between the implants, the distance between the alveolar crest and the hypothetical line that crosses two implants, crest section, tissue quality, arc form crest, freeway space, the distance between the canines, the top of the canine/the distance between the distal teeth of the second molar tooth, canine/molar angle, and arc form prostheses were used as independent variables (Table 1). After a multivariate linear regression analysis (Table 2), it was shown that among the factors evaluated, gender and the distance between the alveolar crest and the hypothetical line that crosses two implants (2c) were significantly associated with QoL of locator-retained mandibular overdenture wearers (p<0.05). The other factors showed no significant effect (p>0.05). The model constructed for 2c showed the value of adjusted R2; 0.321 and the model constructed for 2c and gender showed the value of adjusted R2; 0.413 (Table 2). There was no statistically significant effect between VAS scores and independent variables.

Table 1. Multiple linear regression analysis results (Stepwise)

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Beta In</th>
<th>t</th>
<th>sig</th>
<th>Partial Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. age</td>
<td>-0.241</td>
<td>-1.522</td>
<td>0.141</td>
<td>-0.297</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.333</td>
<td>-2.213</td>
<td>0.037</td>
<td>-0.412</td>
</tr>
<tr>
<td>2a. age of the prosthesis</td>
<td>0.019</td>
<td>0.104</td>
<td>0.918</td>
<td>0.021</td>
</tr>
<tr>
<td>2b. distance between the implants</td>
<td>0.054</td>
<td>0.284</td>
<td>0.779</td>
<td>0.058</td>
</tr>
<tr>
<td>2c. Crest section/round</td>
<td>-0.196</td>
<td>-1.208</td>
<td>0.239</td>
<td>-0.239</td>
</tr>
<tr>
<td>2d. Crest section/sharp</td>
<td>0.196</td>
<td>1.208</td>
<td>0.239</td>
<td>0.239</td>
</tr>
<tr>
<td>2e. Tissue quality/firm</td>
<td>-0.218</td>
<td>-1.334</td>
<td>0.195</td>
<td>-0.263</td>
</tr>
<tr>
<td>2e. Tissue quality/ hyperplastic</td>
<td>-0.022</td>
<td>-0.135</td>
<td>0.894</td>
<td>-0.028</td>
</tr>
<tr>
<td>2e. Tissue quality/mobil</td>
<td>0.229</td>
<td>1.382</td>
<td>0.18</td>
<td>0.271</td>
</tr>
<tr>
<td>2f. Arc form/square</td>
<td>-0.218</td>
<td>-1.334</td>
<td>0.195</td>
<td>-0.263</td>
</tr>
<tr>
<td>2f. Arc form/oval</td>
<td>-0.022</td>
<td>-0.135</td>
<td>0.894</td>
<td>-0.028</td>
</tr>
<tr>
<td>2f. Arc form/ triangle</td>
<td>0.229</td>
<td>1.382</td>
<td>0.18</td>
<td>0.271</td>
</tr>
<tr>
<td>3a. freeway space</td>
<td>0.035</td>
<td>0.213</td>
<td>0.833</td>
<td>0.043</td>
</tr>
<tr>
<td>3b. distance between the canines</td>
<td>0.084</td>
<td>0.4</td>
<td>0.693</td>
<td>0.081</td>
</tr>
<tr>
<td>3e. distance between the canine and molar</td>
<td>0.058</td>
<td>0.351</td>
<td>0.729</td>
<td>0.071</td>
</tr>
<tr>
<td>3d. Canine/molar angle</td>
<td>-0.207</td>
<td>-1.297</td>
<td>0.207</td>
<td>-0.256</td>
</tr>
<tr>
<td>3e. Arc form/square</td>
<td>-0.094</td>
<td>-0.567</td>
<td>0.576</td>
<td>-0.115</td>
</tr>
<tr>
<td>3e. Arc form/oval</td>
<td>0.022</td>
<td>0.135</td>
<td>0.894</td>
<td>0.027</td>
</tr>
</tbody>
</table>
Table 2. Multiple linear regression analysis for quality of life

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>Sig.</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>1.000</td>
<td>1.617</td>
<td>0.618</td>
<td>0.542</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Distance between the alveolar crest and the hypothetical line that crosses two implants</td>
<td>1.500</td>
<td>0.411</td>
<td>0.590</td>
<td>3.649</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>5.901</td>
<td>2.677</td>
<td>2.204</td>
<td>0.37</td>
<td>13.315</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Distance between the alveolar crest and the hypothetical line that crosses two implants</td>
<td>1.532</td>
<td>0.383</td>
<td>0.602</td>
<td>4.004</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b Gender</td>
<td>-3.755</td>
<td>1.697</td>
<td>-.333</td>
<td>-2.213</td>
<td>0.037</td>
<td>10.145</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Discussion

Patient satisfaction is the most important factor determining the success criteria of implant-retained mandibular overdenture prostheses, one that depends on many anatomical factors such as salivary fluidity, viscosity, quality of the alveolar crest, and resilience of soft tissues. Other factors that impact a patient’s satisfaction with the prosthesis are chewing, speech, aesthetics, psychological effects, and the use of a metal or acrylic base prosthesis, retention and stability. In addition, some other factors such as location and number of implants, type of prosthesis and holder type may affect the QoL. This study investigated the relationship between QoL and anatomical, prosthetic features and implant location. The H1 and H2 hypotheses were accepted, and H3 hypothesis was rejected.

In this study, the distance between the alveolar crest and the hypothetical line that crosses two implants impact on QoL was found to be 32 % (p<0.05). The fulcrum axis is the hypothetical line that crosses two implants where rotation movement occurs due to the location of the implant in implant-retained mandibular overdenture prostheses. In order to prevent this movement, the implants must be placed at the most distal and most anterior location. This ratio increased to 41 % when gender factor was added.

Significant consensus has been reached that implant-retained mandibular overdentures can provide important advantages to edentulous patients compared with complete dentures [1]. The effects of various prostheses on QoL have been investigated in many studies, but there are no studies determining which of the anatomical and prosthetic features impact patients’ degree of satisfaction. Preciado et al. [14] only investigated how demographic features, implant-retained overdenture prosthesis features and oral lesion presence impact QoL. They reported that overdenture prostheses with implant retainers improve QoL regardless of implant location, retentive system and antagonist.

The major finding of this study is that the distance between the alveolar crest and the hypothetical line that crosses two implants is the most important factor impacting QoL. This is directly related to implant location. Scherer et al. [24] evaluated effect of implant location and different attachment systems on the retention and stability of 2-implant mandibular implant overdentures that was positively affected QoL and concluded the retention and stability is significantly affected by implant location and abutment type. The vertical retention, horizontal stability and anteroposterior stability increased when the implant position was located distally. Similar results were found in this present study. In addition Ball and Locator attachments have higher levels of retention and stability than O-ring and ERA.

Shayegh et al. [25] evaluated the effect of distance between the implants on the retention of overdentures and the 23 mm distance was found better performance. This present study, mean of distance between the implants was showed 24.3 mm.

One limitation of the research protocol followed here is that the included patients were all from a university dental clinic and the small sample size. Second limitation is that patients who have more than two implants were not included in the study. Lee et al. [26] found no statistically significant difference between 2 and 4 implants for the quality of life of the mandibular implant retained overdentures wearers in their systematic review about the number of implants. Another limitation is that different types of implant-supported overdenture have not been compared. Trakas et al. [27] mentioned their review that there is no significant difference in patient satisfaction either by ball or bar/clip attaching mechanisms. Naert et al. [28] concluded that ball attachment group was showed the best retention and patient satisfaction at year 10. Fernandez-Estevan et al. [29] found that mandibular overdentures retained with the locator system produced good outcomes in terms of QoL and females were more dissatisfied than male. In addition, they found that age factor had a significant effect on OHIP scores. In this present study, the degree of satisfaction was lower in females than males.

In this study, the factors such as anatomical, prosthetic features, and implant location were investigated in terms of affecting the quality of life and the effect percentages. Factors such as the number of implants, attachment type, implant angulation, different opposite arc prostheses, salivary viscosity, changes of nylon retention, relining, and readjustments should be part of future studies. More number of patients and a longer period of observation would yield more consistent results.
Conclusion

Locator-retained mandibular implant overdentures improve the quality of life of edentulous patients. The satisfaction of patients using mandibular overdenture prostheses may depend on many factors, but the location of the implants is very effective in increasing their satisfaction. Within the limitations of the current investigation, the following conclusion may be drawn; the implants should be positioned on the same linear line but at the most distal position to increase patient satisfaction and males were more dissatisfied than male among locator-retained mandibular overdenture wearers.

Competing interests
The authors declare that they have no competing interest.

Financial Disclosure
All authors declare no financial support.

Ethical approval
The approval was obtained from the Ethics Committee of Inonu University. (20/11/2018).

References


