

ATTRIBUTES OF MAXILLARY COMPLETE DENTURE SUPPORTING TISSUES IN SUBJECTS AT A DENTAL HOSPITAL

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ABSTRACT

Objective: To document anatomical features of maxillary edentulous denture supporting tissues (DSTs) in subjects.

Material and Methods: From September 2006 to May 2007, a case-series study, involving 100 subjects having maxillary edentulous DSTs was conducted at KCD Peshawar. Using a structured proforma, data were recorded for un-favourable and favourable features of each of the anatomical structures of the DSTs including radiographic findings and need and category of pre-prosthetic surgical procedures.

Results: Subjects (70 males: 30 females) had mean age $61.3 \pm 10.7SD$ with 34% older than 65 years. Majority (69%) subjects were poor. Caries and periodontal disease were reasons for tooth loss in 99% subjects with mean duration of edentulism in months as $19.5 + 38.3 SD$. The percentages of subjects exhibiting unfavourable features for residual alveolar ridge (RAR) height and width, arch size, maxillary tuberosity, alveolar mucosa and presence of retained roots and teeth on radiographs were 47, 70, 81, 25 and 12 respectively. The percentages of subjects having unfavourable hard palate depth, arch form, soft palatal throat morphology, presence of median palatal fissure, unfavourable labial and buccal border tissue attachment levels, presence of palatal tori and unfavourable tuberosity-sinus relationship were 20, 10, 16, 6, 4, 8, 4, 56 respectively. Need for pre-prosthetic surgery was seen in 18% subjects. Chi-square analyses of data showed significant association between age and oral mucosa, gender and arch size and gender and depth of hard palate.

Conclusion: The unfavourable nature of the DSTs in many subjects indicates their treatment difficulty in a general practice environment.

Key Words: Complete denture, Maxillary edentulous denture supporting tissues, Anatomic structures for maxillary complete denture, complete denture prognosis.

INTRODUCTION

An observed increase in the number of elderly people in both the developed and developing countries who will need conventional complete dentures (CD) has been noted¹⁻⁶. Satisfaction with CD wearing is based on an interplay of psychological, biological, anatomical, and constructional factors⁷⁻⁸. In addition, gender, level of education, self-perception of affective and economic status, and quality of life all influence subjects' satisfaction with CD⁷⁻¹⁰. To successfully treat subjects with CD, innovations and

developments in the materials and technology as well as pre-prosthetic surgical procedures related to conventional CD making have been made. Despite these, there have always been persistent complaints from subjects in the form of function, retention and stability problems with the wearing of technically well-fabricated CD¹¹⁻¹². The conventional CD rely, in part, for its retention and stability on the quality of local anatomy¹³⁻¹⁸. This necessitates the clinician to be well-versed with the basic dental science knowledge. The practitioner must use and apply this knowledge during the clinical assessment of edentulous

Table 1: Description of un-favourable (score 1) and favourable (score 2) features of the various anatomical structures / aspects of the maxillary DSTs.

Un-Favourable (score 1) features of anatomic structures / aspects	Favourable (score 2) features of anatomic structures / aspects
<p>Residual alveolar ridge height / width: Inadequate height but adequate width. Flat ridge (inadequate height and width).</p> <p>Arch size & form: Small size and or Tapering form.</p> <p>Alveolar mucosa: Hypertrophic / Atrophic mucosa</p> <p>Maxillary tuberosity: Bulbous / undercut or moderate to severely resorbed.</p> <p>Hard palate depth: High deep (> 15 mm).</p> <p>Soft palate / Throat Morphology (House 1958): Class III</p> <p>Medium palatal fissure: <i>Present</i></p> <p>Border tissue attachment level (Labial): Less than 7.5 mm apical to the ridge crest.</p> <p>Border tissue attachment level (Buccal): Less than 7.5 mm apical to the ridge crest.</p> <p>Tori: <i>Present.</i></p> <p>Radiographic findings: Retained roots / teeth seen. Sinus floor close to or invading the tuberosity.</p> <p>Need for & category of Pre-prosthetic surgery: Moderate to extensive pre-prosthetic surgery.</p>	<p>Residual alveolar ridge height / width: Round Crest with adequate height and width . Round Crest with adequate height but inadequate width.</p> <p>Arch size & form: Large or medium size and / or Square or Ovoid form</p> <p>Alveolar mucosa: Firm taut over the bone.</p> <p>Maxillary tuberosity: Moderately curved in A-P direction with some vertical inclination in the hamular notch area.</p> <p>Hard palate depth: Shallow or Medium (≤ 15 mm).</p> <p>Soft palate / Throat Morphology (House 1958): Class I or Class II.</p> <p>Medium palatal fissure: Not present.</p> <p>Border tissue attachment level (Labial): More than 7.5 mm apical to the ridge crest.</p> <p>Border tissue attachment level (Buccal): More than 7.5 mm apical to the ridge crest.</p> <p>Tori: Not Present.</p> <p>Radiographic findings: Retained roots/teeth not seen. Sinus floor at a distance from bony tuberosity.</p> <p>Need for & category of Pre-prosthetic surgery: Not needed but if needed it is simple and minor.</p>

subjects so that the formulation and execution of an appropriate treatment planning for edentulous subjects is ensured¹⁸. Among the factors influencing the prognosis of CD, those related to patients' denture supporting tissues (DSTs) should be the first to receive the attention of the treating dentist. Without recognizing the features of the relevant and applied anatomical and pathological conditions of the subjects' DSTs, favourable prognosis of CD therapy is unlikely¹⁸⁻²⁰. Using the classification for complete edentulism of the American College of Prosthodontics (ACP), a significant patients' treatment complexity was seen in a dental teaching school²¹.

The quality of the DSTs that is dependent upon the condition of anatomical structures seems to be more important for successful CD therapy. Large residual ridges provide better support and stability for the denture base than those which are relatively flat and resorbed²²⁻²³. In fact, the continuous reduction of residual ridges in edentulous subjects has been called a major oral disease entity²⁴⁻²⁵. Routine radiographic evaluation had been justified by the positive findings in edentulous patients making CD therapy unfavorable²⁶⁻²⁷. A thorough examination of the mouth prior to CD construction is necessary to identify potential problem areas. As a result, unfavorable conditions have to be treated

medically or corrected surgically prior to denture construction in order to improve denture prognosis and to reduce the number of post-insertion adjustments or to consider alternative treatment approaches including implant-dentures²⁸⁻²⁹.

Keeping in view the influence of the features of anatomical structures of the DSTs on the outcome of CD therapy and the scarce local information on these, it is aimed to present data relating to these structures of the maxillary edentulous DSTs in a group of subjects reporting for CD therapy at the Department of Prosthodontics, Khyber College of Dentistry (KCD) Peshawar, Pakistan.

MATERIAL AND METHODS

During the period from September 2006 to May 2007, a case series study involving 100 subjects having edentulous maxillary DSTs was conducted at the Department of Prosthodontics, KCD Peshawar. Subjects were selected using the non-probability and convenience sampling technique. The study participants had to fulfill the inclusion criteria of having at least maxillary edentulous DSTs, reporting for the first time for CD therapy irrespective of gender and age and with no history of pre-prosthetic surgery or ridge correction work. Excluded from the study were those having gross congenital or surgical defects in

Table 2: The number of subjects exhibiting various scores of the structures etc and their relation with age and gender (n = 100)

Variable	No. of Subjects.	RAR* height & width. Scores**		Arch size. Scores		Maxillary tuberosity. Scores		Alveolar mucosa Scores		Retained roots / teeth etc in OPG. Scores	
		1	2	1	2	1	2	1	2	1	2
		Age Group:									
19 – 50	13	7	6	8	5	12	1	5	8	3	10
51 – 65	53	26	27	40	13	43	10	14	39	4	49
66 – 82	34	14	20	22	12	26	8	6	28	5	29
Total	100	47	53	70	30	81	19	25	75	12	88
Gender:											
Male	70	30	40	43	27	55	15	13	57	9	61
Female	30	17	13	27	03	26	04	12	18	3	27
Total	100	47	53	70	30	81	19	25	75	12	88

RAR = residual alveolar ridge. ** For each of the mentioned structures / aspects, Score 1 makes CD prognosis un-favourable & Score 2 favourable.

their maxillary edentulous DSTs and / or were very ill, handicapped and uncooperative.

After explaining the purpose of the study and obtaining informed consent, data from each subject were collected in a standardized manner using a specifically structured data collection sheet. This facilitated to collect data related to each of the subject's personal information including their age, gender, and socioeconomic status (SES) as well as data pertaining to the various anatomical structures of the maxillary edentulous DSTs. The anatomical structures that were considered as the most important in CD prognosis included; residual alveolar ridge (RAR) height and width, hard palate depth, arch form, arch size, soft palate / throat morphology, median palatal fissure, border tissue attachment levels, alveolar mucosa, maxillary tuberosities, tori, roots / teeth in radiographs, tuberosity-sinus relationship and need and category of pre-prosthetic surgical procedure. Descriptive features of each of the mentioned anatomic structures rendering them as unfavourable (score 1 features) and favourable (score 2 features) are detailed in Table 1.

Each subject was seated in the dental chair. The mentioned anatomic structures of the maxillary edentulous DSTs of each subject were examined clinically by inspection and palpation. An impression of maxillary edentulous DST of each subject was then recorded in impression compound using stock trays. The borders of impression were trimmed and border moulded for function before they were wash-corrected in alginate. Functional depths of labial and buccal sulcus, on each of the accepted impressions, were outlined before pouring casts. On each of the casts, depth of the palate and distance between the crest of the alveolar ridge and muscle attachment levels were measured with a flexible plastic ruler.

A panoramic radiograph of each patient was also taken to see any radiographic abnormalities including retained root and teeth and tuberosity-sinus relationship. Collection of data continued till recording of complete data sets from 100 subjects.

The data for both the qualitative and quantitative variables of age, gender, SES, years of edentulism and ordinal data pertaining to the mentioned anatomic structures of the maxillary DSTs of the subjects were computed and statistically analyzed using the Statistical Package for Social Sciences (SPSS Version 10). Chi-Square test was applied to test the significance of the association of age and gender with the data of the recorded features of the anatomical structures. The level of significance was set at $p < 0.05$.

RESULTS

The mean age of the subjects (70 males and 30 females) was 61.37 ± 10.7 SD years. A large proportion of subjects 69 % (48% males, 21% females) had a poor SES. Their duration of edntulousness ranged from 0.5 to 267 months (22years approximately) with a mean of 19.5 ± 38.3 SD. Most of the subjects (56%) had edentulous maxilla for <5 months before the date of clinical examination for this study. The duration of edntulousness ranged 6-14 months in 12% subjects as compared to 24-60 months in 26% and 66-267 months in 6% subjects. Periodontal disease and / or caries were seen as reasons for becoming edentulous in some 99% subjects with only one female subject who had been rendered edentulous to prevent osteo-radio-necrosis as a consequence of radiotherapy of cancer in the head and neck region.

The distribution of the various unfavourable (score 1) and favourable (score 2) features of the various anatomical structures of the

Table 3: Data for the various scores of hard palate depth, arch form, soft palate / throat morphology and presence or absence of median palatal fissure (n = 100)

Anatomical structure / feature	No. of subjects	Male	Female
Hard Palate Depth:			
Score 1 = High deep (>15mm)	20	17	3
Score 2= Medium deep to flat (upto 15 mm)	80	53	27
Arch Form;			
Score 1 = Tapering	10	6	4
Score 2 = Square or ovoid	90	64	26
Soft Palate / Throat Morphology:			
Score 1 = Class III	16	10	6
Score 2 = Class II & Class I	84	60	24
Median Palatal Fissure:			
Score 1 = Present	6	6	0
Score 2 = Absent	94	64	30

For each of the mentioned structures, Score 1 makes CD prognosis un-favourable and Score 2 favourable

DSTs including the residual alveolar ridge (RAR) height and width, arch size, maxillary tuberosity, alveolar mucosa and of presence / absence of retained roots and teeth on radiographs in the various age groups and gender of the subjects are shown in Table 2. It can be seen that in a great majority of subjects, RAR height and width, arch size, and maxillary tuberosity were found unfavourable and that retained roots and teeth were seen in radiographs of 12 subjects.

Data for the unfavourable (score 1) and favourable (score 2) structures including the depth of hard palate, arch form, soft palatal throat form and presence / absence of median palatal fissure are given in Table 3. Similarly, Table 4 details the data for the unfavourable (score1) and favourable (score 2) features relating to labial and buccal border tissue attachment levels, and for the presence / absence of tori, tuberosity-sinus relationship on radiographs and for need and category of pre-prosthetic surgical procedures. Analyses of the data showed that the only statistically significant associations were seen between the subjects' age and oral mucosa ($X^2 = 60.9$, $df = 42$, $P = 0.03$), gender and arch size ($X^2 = 19.1$, $df = 2$, $P = 0.000$) and between gender and depth of the hard palate ($P = 0.013$).

DISCUSSION

The ratio of 7:3 of male and female edentulous subjects respectively is consistent with another study⁶. A reason for more males being edentulous in the present study is the local tradition and cultural values. In less developed countries, females seek, less frequently, treatments like dental restorations including CD therapy, especially if these treatments are to be provided by male dentists². The finding of high prevalence of

edentulism in the lower SES subjects in this study is also in support of other studies^{3, 5, 30}. The reason for this is the lack of awareness in subjects having poor SES and hence early tooth loss in this group. Another reason for this is that people having favourable SES can afford treatment at private practices. Mostly poor subjects, in this country, seek treatment at government hospitals such as the setting of this study. Untreated caries leading to edentulism in subjects supports the findings of other studies showing that caries was the predominant reason for total tooth loss³¹⁻³². Contrary to these reports, a number of studies have indicated that extractions due to periodontal disease were significant and in fact the major cause for teeth extractions³³⁻³⁵. Most of the subjects in the present study had poor SES and therefore, it is reasonable to assume that they had resorted to treat their involved teeth by extracting them.

Largest proportion (53%) of patients in the present study belonged to the age group 51-65 years. This could also be due to the fact that the mean life expectancy of people lies within these age limits. With advancing age people have more difficulty in adapting to new situations and unable to learning prosthesis manipulation skills. About one third (34%) subjects were in the age group 66-82 years. These elderly subjects will pose a significant problem to general dental practitioners and would require referral to a specialist dentist.

Favorable anatomical structures of the DSTs have been considered to promote retention, stability and hence the efficacy and acceptability of CD. Clinically this can be assessed by the degree of alveolar ridge resorption, the size, shape and consistency of the ridge and by the level of the muscle attachments²². The ideal shape of maxillary edentulous ridge is the U-shape, with

parallel walls and a broad, well-rounded crest. This type of ridge is most conducive to facilitate well-supported, stable and retentive dentures^{25, 36}. In this study the Cawood and Howell classification for edentulous jaws³⁷ was used to assess the form of the edentulous ridge. Clinical examination of the subjects revealed 53% had favorable RARs (Table 2). Only 10% subjects had severely resorbed RARs. This is contrary to the findings of 15.78% most favorable and 84.2% least favorable of another study using a different classification system²¹. This disagreement may be the result of difference in the number of subjects included in the study, methodology and classification system used. The difference could also be explained by the differences in the mean ages of the two populations. In addition, duration of edentulousness and denture wearing are associated with increased residual ridge resorption (RRR)²⁵. In the present study, all the subjects reported for the first time for CD therapy and 56% subjects reported for CD in the first few months after becoming edentulous. This could be another reason for the favorable DSTs in these subjects. Another 44% reported after six months to 22 years. Some 32% subjects had been remaining edentulous for a long time, ranging from over five years to 22 years.

There is an association between the size of the edentulous arches and residual ridges and the age of the subjects. Young old subjects tend to have larger arches and ridges than the old elderly

subjects. In addition, advanced age is associated with more RRR and consequently makes the situation more complex²¹. In the present study, favorable anatomical landmarks including well-rounded RARs and large-medium arch sizes and square-ovoid arch forms were found in 53%, 30% and 90% subjects respectively (Tables 2 and 3).

The present study showed that amongst the subjects, majority had normal and only 4-8% had unfavorable border tissue attachments (Table 4). This was despite the severely resorbed RARs in 10% subjects. This mis-match could be because of the material and method used in taking impression of the edentulous subjects. In this study, impressions were taken in impression compound and were wash-corrected in alginate using stock trays. Although, extreme care had been exercised to avoid excessive displacement of sulcus tissues, it would be better if results not different than ours could be recorded with the use of special trays and a relatively less viscous mix of impression material for functional moulding of sulcus tissues.

Palate shapes have been reported to influence the retention of maxillary CDs. Medium vault palates have better denture retention as well as favorable stability potential compared to those that are deeper. Similarly, arch form, arch size and from, soft palate form and absence of median palatal fissure are all important for the retention, stability and support of maxillary CD.²² These anatomic landmarks in most subjects in this study

Table 4: Data for the scores of border tissue attachments, palatal tori, radiographic findings and need and category of the preprosthetic surgical procedure (n= 100)

Anatomic structure / feature / aspect	No. of subjects (N=100)	Male (N=70)	Female (N=30)
Border tissue attachments (Labial):			
Score 1 = 2.5 mm or less from the ridge crest.	4	2	2
Score 2 = > 2.5 mm from the ridge crest.	96	68	28
Border tissue attachments (Buccal):			
Score 1 = 2.5 mm or less from the ridge crest.	8	3	5
Score 2 = > 2.5 mm from the ridge crest.	92	67	25
Palatal tori:			
Score 1 = Present.	4	4	0
Score 2 = Absent.	96	66	30
Tuberosity - sinus relationship on OPG:			
Score 1 = Unfavourable.	56	41	15
Score 2 = Favourable.	44	29	15
Need for pre-prosthetic surgical procedure;			
Score 1 = Yes.	18	12	6
Score 2 = No.	82	58	24
Category of pre-prosthetic surgical procedure:			
Score 1 = Moderate to extensive.	9	5	4
Score 2 = Simple / minor / not needed.	91	65	26

For each of the mentioned structures/ aspects, Score 1 makes CD prognosis un-favourable & Score 2 favourable.

(Table 3) were favorable for CD prognosis subjects except maxillary tuberosity which was unfavourable in 81% (Table 2). These were moderately resorbed in more than half (52%) and severely resorbed in 29% subjects. The severe resorption of maxillary tuberosity may be the consequence of early extraction of grossly carious molar teeth which was the main cause of total tooth loss in the studied subjects. The extractions might also have been traumatic with substantial loss of alveolar process and maxillary tuberosities in these 29% subjects.

The way the soft palate is dropping towards the throat is directly related to the depth of hard palate and size of maxillary tuberosities. High deep palates and poorly defined maxillary tuberosities are associated with the most unfavorable Class III soft palates as compared to the relatively moderately shallow or flat hard palatal vaults seen either with Class I or Class II soft palates^{23, 38, 39}. In the present study, 84% subjects had either Class I or II soft palate/throat morphology, while high deep hard palates were seen in 16% subjects (Table 3). In contrast, out of the total 81% unfavourable maxillary tuberosities (Table 2), in 29% subjects they were severely resorbed. Except deep hard palate, presence of median palatal fissure, presence of palatal tori and abnormal tuberosity-sinus relations which were lower in proportions, the proportions of the other unfavourable anatomical features of the DSTs were higher in female subjects as compared to male subjects. However, this finding need to be interpreted with caution because of inclusion of more male subjects and using a non-probability convenience sampling technique for selection of the sample population in the study.

With advancing age, the oral mucosa becomes less resilient and atrophic⁴⁰. Seventy five percent subjects in this study exhibited normal alveolar mucosa. This indicates good mucosal health of subjects despite their old age. The highly significant relation of gender and arch size indicate the association of medium or large arch size in males and medium or small arch size in females. The association of small arch size and female gender may be attributed to the general body development of females. As reported by others, the small arch size may also be the result of postmenopausal osteoporosis^{24, 41} it is to note that 29% of the females in this study were older than 40 years.

The presence of torus palatinus (TP) in 4% subjects of this study is not in agreement with studies conducted on other Asian populations^{42, 43}. A reason for this disagreement may be the small number of subjects included in this study. The

other reason for this may be the influence of genetic and environmental factors including masticatory stress and nutritional factors^{43, 44}. Some 12% panoramic radiographs of the subjects revealed positive findings. Four percent of them had impacted teeth and 4% had root remnants which are in agreement with others⁴⁵. This necessitates the importance of routine radiographic survey as a method for investigation and detailed assessment. This approach when made a routine will also safeguard the practitioner against possible medico legal problems.

Of the total 100 patients, 18% required pre-prosthetic surgery either to remove impacted teeth (4%), root remnants (4%) or alveoloplasty for correcting spiny projections (4%) or improving the denture supporting area through vestibuloplasty in 4%. Two subjects required ridge augmentation to make the denture prognosis favorable. Some one-third (34%) subjects were older than 65 years. Management of subjects beyond this age with reduced adaptive capabilities, and specifically those having unfavourable anatomical structures in their DSTs, will present a challenging situation for the general practitioners.

CONCLUSION

Notwithstanding the varying proportions of the unfavourable physical attributes of the denture supporting tissues, there were also many subjects older than 65 years age. These certainly suggest the provision of complete denture therapy in a clinical environment with specialists' expertise.

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