Original Article

Chewing Side Preference – Impact on Facial Symmetry, Dentition and Temporomandibular Joint and its Correlation With Handedness

Shreyasi Tiwari, Supriya Nambiar, Bhaskaran Unnikrishnan[1]

Department of Orthodontics, Manipal College of Dental Sciences, [1]Department of Community Medicine, Kasturba Medical College, Mangalore, India

Abstract

Introduction: Habitual unilateral chewing develops subconsciously and serves as an example for lateral preference. This study aims to assess the possible impact of chewing side preference to facial asymmetry, temporomandibular joint (TMJ) and oral hygiene and existence of any link between the preferred chewing side (PCS) and handedness. **Materials and Methods:** A 2-month cross-sectional (observational) study was performed on 76 healthy dentate subjects [24 males (31.6%) and 52 females (68.4%)] with a mean age of 20.8 ± 1.5 years who participated in this study according to the selection criteria. **Results:** A total of 75 subjects out of 76 (98.6%) were observed to have a PCS. Out of them, 38 chewed on their right and 37 on the left side. Of the 74 right-handed subjects, 48.6% chewed on the right, 50% on the left and 1.4% chewed equally on both the sides. **Conclusion:** Chewing side preference has a detrimental effect on the TMJ of the corresponding side and is also related to lateral facial asymmetry, which suggests that examination and recording of chewing side preference merit consideration in routine dental examination and treatment planning.

Keywords: *Oral health, TMJ, unilateral chewing*

Introduction

The physiology and biophysics of the natural mastication of humans plays an important role in understanding the development of the stomatognathic system.[1,2] Mastication can be bilateral or unilateral. For most of the human activities, there exists a 'lateral preference', that is a tendency to use one side of the body more than the other. Habitual unilateral chewing develops subconsciously and may serve as an example for lateral preference. Several studies have been performed to link the preferred chewing side (PCS) to handedness, but they were unable to derive a definite link between these two attributes.[3]

Unilateral chewing habits of individuals have been cited as one of the possible etiological factors of lateral facial asymmetry that can worsen over the years,[4,5] which may be due to the under-development of the non-chewing side and relative development of the chewing side. It is commonly accepted that unilateral chewing has a potentially high traumatic effect on the temporomandibular joint (TMJ).[6] The mechanical stresses from mastication affect the TMJ as well as the dento-facial morphology[7,8] chronic unilateral chewing during developmental stages could predispose an individual to temporomandibular disorders (TMD) characterised by pain in the pre-auricular area and the TMJ, soreness of masticatory muscles, limitation/deviation during opening/closing of the mouth in the lower jaw, noises in the TMJ during mandibular function, restricted mobility and trismus.

Unilateral masticatory habit usually leads to accumulation of plaque and calculus on the contralateral side, leading to dental caries and gingival and periodontal problems.[9,10] However, there is a lack of research to link chewing side preference with oral hygiene status quantitatively. Thus, this study would aim to assess the impact of chewing side preference on facial symmetry and the TMJ. Another objective was to compare and contrast the oral hygiene of the two sides of the mouth by assessing carious status, gingival status and periodontal status of each side.

Materials and Methods

Ethical approval for this study, protocol no MCODS/198/2013 and ref no 12075 (Institutional Ethical Committee) was

How to cite this article: Tiwari S, Nambiar S, Unnikrishnan B. Chewing side preference - impact on facial symmetry, dentition and temporomandibular joint and its correlation with handedness. J Orofac Sci 2017;9:22-7.

Address for correspondence:
Dr. Supriya Nambiar, Associate Professor, Department of Orthodontics and Dentofacial Orthopedics, Manipal College of Dental Sciences, Mangalore, Karnataka, India.
E-mail: nambiar.supriya@gmail.com

Access this article online

Website: www.jofs.in

DOI: 10.4103/jofs.jofs_74_16

Quick Response Code:

provided by the Ethical Committee of Manipal college of dental sciences affiliated to Manipal University, Mangalore, on 9th February 2013. The study was performed on dental students as a cross-sectional (observational) study. Subjects were provided with a patient information sheet with no emphasis on the chewing side, to reduce bias, and a written informed consent was obtained in English. The Fédération dentaire internationale (FDI) tooth numbering system was used in the study. The sample comprised of 76 healthy dentate subjects [24 males (31.6%) and 52 females (68.4%)] with a mean age of 20.88 ± 1.54 years. All individuals with full dentition (except third molars) and good/fair oral and general health were included and individuals with noticeable facial deformities or disfigurement, severe malocclusion, periodontal scaling done within the last 2 months, history of periodontal breakdown, history of parafunctional habits, history of maxillofacial surgery or jaw injuries and orthodontic treatment concluded in the last 2 years were excluded from the study.

The decayed missinf filled surfaces (DMFS) Index was used for the carious status and was assessed for only the posterior teeth (pre-molars and molars) of each side of the mouth separately. The scores for the two sides were then compared. Silness and Loe's Plaque Index was assessed for the four gingival areas (disto-facial, facial, mesio-facial and lingual surfaces) of only the maxillary and mandibular first molars (tooth numbers: 16, 26, 36 and 46, respectively). The scores were calculated separately for both the sides of the mouth and then, compared to each other. The two sides of the mouth were also checked for the presence of calculus. Assessment was done by employing Loe and Silness' Gingival Index, and the teeth in consideration were maxillary and mandibular first molars (tooth numbers: 16, 26, 36 and 46, respectively). The scores were calculated separately for the two sides of the mouth and then, compared to each other. Periodontal status was assessed by measuring the depth of gingival sulcus with respect to the maxillary and mandibular permanent first molars (tooth numbers: 16, 26, 36 and 46, respectively). The average probing depth was calculated for the right side (with respect to tooth numbers 16 and 46) and the left side (with respect to tooth numbers 26 and 36) and compared to each other.

Determination of chewing side preference was done by a visual spot-checking method in which subjects were instructed to chew gum on their posterior teeth, while filling out an anonymous questionnaire. After a 15 s time interval, they were asked to stop chewing and to smile to observe the side on which the gum is positioned (right or left). This process was performed twice. This was further confirmed by asking the subjects to chew 4–5 almonds (as test food), while a video camera recorded the displacement of the chin. A slow-speed video playback was used to identify the observed preferred chewing side (OPCS). Through a well-designed questionnaire, self-awareness of one's chewing habit and handedness were found (after the visual spot-checking and confirmatory chewing tests were performed) and compared to the respective subject's OPCS.

Facial symmetry was determined by checking for chin deviation from the midline and comparison of the widths of the lateral halves of the face by clinical examination in which the two lateral halves of the subject's face were assessed by overhead view. This was confirmed by facial photography using a frontal photo in which midline (line joining the glabella and philtrum of upper lip) was marked, and it was assessed as to which side the chin deviates from the line. The left and right sides of the facial photograph were cut in the median line and were re-united with the mirror images of their respective halves using the software 'Inverted Image 2.3.5' (software company: ZXT 2007; Freeware). In this way, two facial photos were reconstructed using the mirror images of the two sides of the face. This helped in determining which hemiface (left/right) is wider than the other. Photo of the face taken from below the chin-up was also used, and the lateral halves of the face were compared and the chin deviation was assessed.

The subjects were asked for any history regarding the TMJ, which includes pain in the joint, difficulty in wide opening of the mouth, and joint sounds heard while opening of the mouth in the written questionnaire. This was followed by a clinical examination which involved an inspection of the joint (the subject was asked to open/close the mouth to observe for mandibular deviation or deflection from the midline during joint movement), palpation of the joint (to check for tenderness) and auscultation of the joint (to check for joint sounds – clicking: unilateral/bilateral).

Results

A total of 75 subjects out of 76 (98.6%) were observed to have a PCS. Out of them, 38 chewed on their right side and 37 on the left side. Only one subject was observed to chew equally on both the sides. Regarding the chewing preferences of the 75 subjects, who were observed to have a definite PCS, 52% were not aware of their habit to prefer a particular side for chewing. Of the 74 right-handed subjects, 48.6% chewed on the right, 50% on the left and 1.4% chewed equally on both the sides [Table 1]. 85.5% of the subjects presented with chin deviation from the midline, of which 60.6% chewed from their right side. Among the people with chin deviation towards left, 59.4% chewed from their left side [Table 2]. 92.1% of the subjects presented with a wider hemiface. Of the people with wider right hemiface, 69.6% chewed on their right. Among the ones with wider left hemiface, 87.5% chewed on the left [Table 3]. The correlation between 'OPCS' and 'comparison of lateral facial halves' was found to be statistically significant ($P < 0.05$).

57.9% of the individuals presented with jaw deviation/deflection towards a particular side during TMJ function. The correlation between 'OPCS' and 'jaw deviation/deflection' was found to be

Table 1: Observed preferred chewing side ('opcs') v/s handedness

Handedness ('A')	Observed preferred chewing side (OPCS)			Total no. [% of sample size (*n*=76)]	*P* value
	Right No. (% of 'A')	Left No. (% of 'A')	None No. (% of 'A')		
Right	36 (48.6%)	37 (50.0%)	1 (1.4%)	74 [97.3%]	0.358
Left	2 (100.0%)	0 (0.0%)	0 (0.0%)	2 [2.7%]	
Total	38 (50.0%)	37 (48.7%)	1 (1.3%)	76 [100.0%]	

Table 2: 'opcs' v/s chin deviation from midline

Chin deviation ('B') towards	Observed preferred chewing side (OPCS)		Total no. [% of sample size (*n*=76)]	*P* value
	Right No. (% of 'B')	Left No. (% of 'B')		
Right	20 (60.6%)	13 (39.4%)	33 [43.4%]	0.071
Left	13 (40.6%)	19 (59.4%)	32 [42.1%]	
Total	33 (50.7%)	32 (49.3%)	65 [85.5%]	

Table 3: 'opcs' v/s comparison of lateral facial halves

Wider hemiface ('C')	Observed preferred chewing side (OPCS)		Total no. [% of sample size (*n*=76)]	*P* value
	Right No. (% of 'C')	Left No. (% of 'C')		
Right	32 (69.6%)	14 (30.4%)	46 [60.5%]	0.000
Left	3 (12.5%)	21 (87.5%)	24 [31.6%]	
Total	35 (50.0%)	35 (50.0%)	70 [92.1%]	

Table 4: 'opcs' v/s mandibular deviation/deflection

Jaw deviation/ deflection ('D') towards	Observed preferred chewing sidE (OPCS)		Total no. [% of sample size (*n*=76)]	*P* value
	Right No. (% of 'D')	Left No. (% of 'D')		
Right	20 (83.3%)	4 (16.7%)	24 [31.6%]	0.000
Left	1 (5.0%)	19 (95.0%)	20 [26.3%]	
Total	21 (47.7%)	23 (52.3%)	44 [57.9%]	

Table 5: 'opcs' v/s clicking of TMJ

TMJ clicks ('E') towards	Observed preferred chewing side (OPCS)		Total no. [% of sample size (*n*=76)]	*P* value
	Right No. (% of 'E')	Left No. (% of 'E')		
Only right	7 (63.6%)	4 (36.4%)	11 [14.5%]	0.358
Only left	4 (26.7%)	11 (73.3%)	15 [19.7%]	
Both R&L	8 (47.1%)	9 (52.9%)	17 [22.4%]	
Total	19 (44.2%)	24 (55.8%)	43 [56.6%]	

Table 6: 'opcs' v/s DMFS index score

Higher DMFS score ('F') towards	Observed preferred chewing side (OPCS)		Total no. [% of sample size (*n*=76)]	*P* value
	Right No. (% of 'F')	Left No. (% of 'F')		
Right	1 (4.0%)	24 (96.0%)	25 [32.9%]	0.000
Left	21 (91.3%)	2 (8.7%)	23 [30.2%]	
Total	22 (45.8%)	26 (54.2%)	48 [63.1]	

statistically significant ($P < 0.05$) [Table 4]. 56.6% of the subjects had TMJ clicks, of whom 39.5% had bilaterally clicking TMJs [Table 5]. The correlation between 'OPCS' and 'carious status' was found to be statistically significant ($P < 0.05$) [Table 6]. The correlation between 'OPCS' and 'plaque' was found to be statistically significant ($P < 0.05$) [Table 7]. A total of eight people (10.5%) showed the presence of calculus, of whom four had more calculus towards the right (all left-chewers) and four had more calculus towards the left (all right-chewers) [Table 8]. All of the left-side chewers had a greater gingival index score [Table 9] and greater mean probing depth [Table 10] for the right side of the mouth, whereas 93.3% of the right-side chewers had a greater score for the left side of the mouth and 92.3% of the right-side chewers had greater mean probing depth towards the left side of the mouth. The correlation between 'OPCS' and 'periodontal health (gingival index and periodontal probing depth)' was found to be statistically significant ($P < 0.05$). Both of the left-handed individuals had a higher plaque index (PI) score on the left, whereas, of the right-handed subjects who showed unequal PI scores for the two sides of the mouth, 54.5% had more plaque towards the left side [Table 11]. Of the eight subjects who showed presence of calculus, 50% had more calculus deposits towards right side (all of them right-

Table 7: 'opcs' v/s plaque index (PII) score

Higher PII score ('G') towards	Observed preferred chewing side (OPCS)		Total no. [% of sample size (*n*=76)]	*P*value
	Right	Left		
	No. (% of 'G')	No. (% of 'G')		
Right	2 (5.6%)	34 (94.4%)	36 [47.3%]	0.000
Left	31 (96.9%)	1 (3.1%)	32 [42.1%]	
Total	33 (48.5%)	35 (51.5%)	68 [89.4%]	

Table 8: 'opcs' v/s presence of calculus

More calculus ('H') towards	Observed preferred chewing side (OPCS)		Total no. [% of sample size (*n*=76)]	*P* value
	Right	Left		
	No. (% of 'H')	No. (% of 'H')		
Right	0 (0.0%)	4 (100.%)	4 [5.2%]	0.084
Left	4 (100.0%)	0 (0.0%)	4 [5.2%]	
Total	4 (50.0%)	4 (50.0%)	8 [10.5%]	

Table 9: 'opcs' v/s gingival index (GI) score

Higher GI score ('I') towards	Observed preferred chewing side (OPCS)		Total no. [% of sample size (*n*=76)]	*P* value
	Right	Left		
	No. (% of 'I')	No. (% of 'I')		
Right	0 (0.0%)	12 (100.0%)	12 [15.8%]	0.000
Left	14 (93.3%)	1 (6.7%)	15 [19.7%]	
Total	14 (51.9%)	13 (48.1%)	27 [35.5%]	

Table 10: 'opcs' v/s mean periodontal sulcus depth

Greater probing depth ('J') towards	Observed preferred chewing side (OPCS)		Total no. [% of sample size (*n*=76)]	*P* value
	Right	Left		
	No. (% of 'J')	No. (% of 'J')		
Right	0 (0.0%)	7 (100.0%)	7 [9.2%]	0.002
Left	12 (92.3%)	1 (7.7%)	13 [17.1%]	
Total	12 (60.0%)	8 (40.0%)	20 [26.3%]	

Table 11: Handedness v/s plaque index (PII) score

Higher PII score ('G') towards	Handedness		Total no. [% of sample size (*n*=76)]	*P* value
	Right	Left		
	No. (% of 'G')	No. (% of 'G')		
Right	36 (100.0%)	0 (0.0%)	36 [47.3%]	0.244
Left	30 (93.8%)	2 (6.3%)	32 [42.1%]	
Total	66 (97.1%)	2 (2.9%)	68 [89.4%]	

Table 12: Handedness v/s presence of calculus

More calculus ('H') towards	Handedness		Total no. [% of sample size (*n*=76)]	*P* value
	Right	Left		
	No. (% of 'H')	No. (% of 'H')		
Right	4 (100.0%)	0 (0.0%)	4 [5.2%]	0.016
Left	3 (75.0%)	1 (25.0%)	4 [5.2%]	
Total	7 (87.5%)	1 (12.5%)	8 [10.5%]	

handed) and 50% had more calculus towards the left side (25% of them left-handed). Although the correlation between handedness and calculus was statistically significant ($P < 0.5$), there was a lack of clinical significance for the same [Table 12]. 65.7% of the subjects with asymmetric widths of lateral facial halves had a wider right hemiface. The remaining who had wider left hemifaces were all right-handed [Table 13].

Discussion

This cross-sectional study examined the prevalence and self-awareness of chewing side preference and correlation of PCS with handedness, facial asymmetry, TMJ and oral hygiene in a sample population of 76 young adults [24 males (31.6%) and 52 females (68.4%), with a mean age of 20.8 ± 1.5 years].

For assessing the PCS, two test foods were used: chewing gum (soft) for the preliminary test and almonds (hard) for the confirmatory test. This was so because food texture influences the side preference.[11]

The study confirmed that bilateral chewing is common, which is in agreement with other studies.[3,12] Almost equal prevalence of the right and left chewing sides was observed, as found by Pond *et al.*[12] However, no significant relationship was observed between PCS and handedness, as was the case in the study conducted by Martinez-Gomis *et al.*[3] In addition, this study also tried to analyse the self-awareness of chewing side preference among unilateral chewers and found that more than half of the individuals with a definite chewing side were

Table 13: Handedness v/s comparison of lateral facial halves

Wider hemiface ('C')	Handedness		Total no. [% of sample size (n=76)]	*P* value
	Right	Left		
	No. (% of 'C')	No. (% of 'C')		
Right	44 (95.7%)	2 (4.3%)	46 [60.5%]	0.512
Left	24 (100.0%)	0 (0.0%)	24 [31.6%]	
Total	68 (97.1%)	2 (2.9%)	70 [92.1%]	

not aware of their habit to prefer a particular side during chewing.

In this study, facial symmetry was assessed clinically as well as by using frontal facial photographs, and a significant correlation was found between facial symmetry and widths of the lateral facial halves. Of the 70 individuals (92% of the total) who presented with unequal widths of lateral facial halves, a wider hemiface was observed corresponding to the side of chewing preference in 75% of the cases. This may be explained by the hypothesis that mechanical stresses from mastication result in functional adaptive response by the facial bones, particularly the mandible.[7] This study made use of only clinical examination and photography for assessment of lateral facial asymmetry, but a better and more precise analysis of the same can be made by using radiographic aids.

TMJ examination was done to assess joint pain/tenderness, TMJ clicks and mandibular deviation/deflection on the mouth opening. Chewing side preference has been associated with unilateral signs and symptoms of TMD,[6,13] which may be the result of the morphological changes that take place in the TMJ due to unilateral mastication.[8] This study also found a significant correlation between PCS and jaw deviation/deflection during TMJ function (i.e. during the mouth opening); 58% of the population presented with mandibular deviation during TMJ function, of whom 89% showed deviation towards the chewing side. Thus, chewing side preference has a possible detrimental effect, mainly on the TMJ corresponding to the PCS. However, there was a lack of significant relationship between TMJ clicks and chewing side preference. This might be due to the fact that the subjects were selected from a general population. Since this was not a case–control study, TMD symptoms were not severe enough for the subjects to seek treatment. This may explain the lack of statistical support in this study.

Unilateral masticatory habit leading to accumulation of plaque and calculus on the contralateral side has not seen much quantitative research; therefore, dental indices were used in this study. Significant correlation of PCS was found with dental caries (using DMFS Index), plaque (using Plaque Index) and periodontal health (using Gingival Index and calculating mean depth of periodontal sulcus). The number of subjects who presented with different index scores for the two sides of the mouth was recorded, and it was then assessed as to which side of the mouth had greater score. 90% of the individuals presented with unequal plaque scores for the two sides of the mouth, and 95% of them had more plaque on the side opposite to their chewing side. As plaque is the main etiologic factor for dental caries and periodontal diseases, the observations pertaining to carious, gingival and periodontal statuses were also in accordance to that of the plaque status. Hence, subjects with chewing side preference have a comparatively poor oral hygiene status in the side of the oral cavity opposite to their respective chewing sides.

An individual's handedness is also an important factor in determining the relative oral hygiene statuses of the two sides of the mouth. Right-handed subjects have better ability to access the left quadrants of the mouth to perform oral hygiene procedures, resulting in better plaque control in the left side of the mouth (and vice versa); this was studied by Kadkhodazadeh *et al.*[14] In this study, statistically significant correlation was found between handedness and presence of dental calculus in the oral cavity, but the relationship of handedness to plaque index scores was not statistically significant. This might be due to the fact that plaque was assessed only on certain index teeth and that too only in their gingival areas. Disclosing agents for plaque assessment can be used to get better results in this field.

Conclusion

This study has helped to determine the correlation of chewing side preference with facial asymmetry, TMD and oral hygiene status. Since the awareness of this habit is low among the population, it necessitates the need to spread awareness of unilateral mastication and its ill-effects in the dento-facial region. Chewing side preference causes relative development of the corresponding side of the face in relation to the other half, resulting in lateral facial asymmetry. It also has a harmful effect on the TMJ corresponding to the chewing side, thereby predisposing to TMJ disorders. The oral hygiene status of the contralateral side is adversely affected, predisposing it to caries and periodontal issues. The findings suggest that examination and recording of chewing side preference merits consideration in routine dental examination and treatment planning. However, further investigation is needed to clarify the clinical relevance of these findings. Because of the cross-sectional design of this study, it cannot be demonstrated whether chewing side preference is the cause or the result of facial asymmetry, TMD and poor oral hygiene. Longitudinal studies are needed to clarify the cause–effect scenario of these correlations.

Acknowledgements

We acknowledge and thank Indian Council of Medical Research for the funding of this short term research project and Dr. Siddarth Shetty, Professor and Head, Department of Orthodontics, Manipal College of Dental Sciences, Mangalore, a constituent college of Manipal University, for all the help provided for the study.

Financial support and sponsorship

The study was funded by ICMR as a short term student research project.

Conflicts of interest

There are no conflicts of interest.

References

1. Santos CE, de Freitas O, Spadaro AC, Mestriner-Junior W. Development of a colorimetric system for evaluation of the masticatory efficiency. Braz Dent J 2006;17:95-9.
2. van der Bilt A, Engelen L, Pereira LJ, van der Glas HW, Abbink JH. Oral physiology and mastication. Physiol Behav 2006;89:22-7. Epub 2006 Mar 29.
3. Martinez-Gomis J, Lujan-Climent M, Palau S, Bizar J, Salsench J, Peraire M. Relationship between chewing side preference and handedness and lateral asymmetry of peripheral factors. Arch Oral Biol 2009;54:101-7.
4. Cheong YW, Lo LJ. Facial asymmetry: Etiology, evaluation, and management. Chang Gung Med J 2011;34:341-51.
5. Shah SM, Joshi MR. An assessment of asymmetry in the normal craniofacial complex. Angle Orthod 1978;48:141-8.
6. Diernberger S, Bernhardt O, Schwahn C, Kordass B. Self-reported chewing side preference and its associations with occlusal, temporomandibular and prosthodontic factors: Results from the population-based Study of Health in Pomerania (SHIP-0). J Oral Rehabil 2008;35:613-20.
7. Sato H, Kawamura A, Yamaguchi M, Kasai K. Relationship between masticatory function and internal structure of the mandible based on computed tomography findings. Am J Orthod Dentofacial Orthop 2005;128:766-73.
8. Jiang H, Wang ZW, Liu HC, Hu M, Cao JK, Shi XW. Effect of right chewing-side preference on morphological temporomandibular joint changes. Shanghai Kou Qiang Yi Xue 2010;19:607-10.
9. Sjögren K, Lingström P, Lundberg AB, Birkhed D. Salivary fluoride concentration and plaque pH after using a fluoride-containing chewing gum. Caries Res 1997;31:366-72. doi: 10.1159/000262420
10. Choudhari S, Pendyala G, Raurale A, Joshi S. Unilateral pathology associated with bilateral etiologies. Contemp Clin Dent 2011;2: 394-7.
11. Paphangkorakit J, Thothongkam N, Supanont N. Chewing-side determination of three food textures. J Oral Rehabil 2006;33:2-7.
12. Pond LH, Barghi N, Barnwell GM. Occlusion and chewing side preference. J Prosthet Dent 1986;55:498-500.
13. Reinhardt R, Tremel T, Wehrbein H, Reinhardt W. The unilateral chewing phenomenon, occlusion, and TMD. Cranio 2006;24: 166-70.
14. Kadkhodazadeh M, Khodadustan A, Amid R, Darabi A. Plaque removal ability in left- and right-handed patients in different parts of the oral cavity. J Periodontol Implant Dent 2012;4.