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Is the side with the best masticatory performance selected for chewing?

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ARTICLE INFO

Article history:
Accepted 7 August 2014

Keywords:
Side of mastication
Masticatory efficiency
Masticatory laterality
Artificial test food
Mastication

ABSTRACT

Objective: This study assessed the degree of relationship between masticatory laterality and lateral asymmetry of masticatory performance using silicon pieces enclosed in a latex bag.
Design: Forty-two young adults with natural dentition participated in this cross-sectional, observational study. They performed four different masticatory assays, each consisting of five trials of chewing three pieces of silicon for 20 cycles. In one assay, they were asked to masticate unbagged silicon free-style, whilst in the three other assays they were asked to masticate bagged silicon free-style, unilaterally on the right-hand side and unilaterally on the left-hand side. The preferred chewing side was determined by calculating the asymmetry index for both the free-style assays. Masticatory performance was determined by sieving the silicon particles and the cycle duration was also recorded. Data were analysed using independent samples or paired *t*-test and linear regression.
Results: Masticatory function using the bagged silicon was similar to that using the unbagged silicon. A significant and positive relationship was observed between the preferred chewing side expressed as the asymmetry index and the side with better masticatory performance. Alternate unilateral chewers demonstrated better masticatory performance than unilateral chewers. However, when free-style and unilateral chewing were compared for each subject, unilateral chewing was found to be as efficient as – or even more efficient than – free-style chewing.
Conclusions: There is a positive association between the preferred chewing side and the more efficient side. Alternate unilateral mastication *per se* does not promote better masticatory performance than consistently unilateral mastication.

1. Introduction

One of the main objectives of dental treatment is to restore or improve masticatory function, which is evaluated by self-assessment of chewing ability and/or objective masticatory performance measured using laboratory tests.[1] Whereas masticatory function can be studied recording the chewing pattern simultaneously with the muscular activation of the masticatory muscles,[2] masticatory performance can be determined by quantifying the degree of fragmentation of an artificial test food after a set number of chewing cycles.[3]

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http://dx.doi.org/10.1016/j.archoralbio.2014.08.005
0003–9969/

Number of teeth, occlusal contact area, bite force and salivary flow, are all factors that can affect masticatory performance.[4]

Although mastication may occur bilaterally or alternating both sides, it is thought that the majority of people chew more on one particular side, i.e. they have a preferred chewing side (PCS).[5–7] The proportion of children or adults with a PCS ranges from 45% to 98%,[7–11] and there is no agreement on whether the right side is used more frequently than the left side.[8–10,12,13] Furthermore, it still unknown whether the PCS is centrally determined or related to peripheral factors, nor which peripheral factors are most closely related to the PCS.[7,10,11]

Although natural foods can be used to assess masticatory function, artificial test food can be easily standardised and its physical properties remain the same over time.[14] Consequently, the use of artificial test foods such as silicon impression material is reliable.[15] It has been shown that tough and hard foods, as well as materials with high cohesiveness that do not disintegrate are more appropriate to determine the PCS.[9,16–18] Real food placed in a latex bag has also been used to assess the masticatory function.[19,20] Theoretically, the best test food to assess the PCS would be one which formed an artificial, hard and cohesive (non-committable) bolus. Placing the artificial test food in a latex bag seems to be the method that best guarantees the bolus cohesiveness.

Bite force and occlusal contact area are the best predictors of variation in masticatory performance,[21–23] and lateral differences in these parameters are positively correlated with masticatory laterality.[9,10] It has been reported that masticatory performance tends to be better on the preferred side; however, no significant correlation has been found between chewing side preference and masticatory performance.[24] Although it seems plausible that side efficiency could affect chewing side preference, to our knowledge no studies have demonstrated a direct relationship between asymmetry of masticatory performance and chewing side preference. Although bilateral chewers seem to present better masticatory performance than unilateral chewers,[18] no direct association has been demonstrated.

The first aim of this study was to assess the degree of relationship between masticatory laterality and lateral asymmetry of masticatory performance, using silicon tablets enclosed in a latex bag as a test food in young adults with natural dentition. The second aim was to determine whether free-style mastication achieves better efficiency than unilateral mastication.

2. Material and methods

2.1. Subjects

Forty-two young adults (23 women and 19 men) with natural dentition were selected from volunteer students and staff at the University of Barcelona Faculty of Dentistry (Barcelona, Spain) to participate in this cross-sectional study. Their ages ranged from 21 to 45 years old with a mean age of 26.8 (SD = 4.9) years. Among the participants, 31 had Angle class I bilaterally and 11 had unilaterally or bilaterally class II. No subject had severe malocclusion. Subjects with fewer than 24 natural teeth, those undergoing active orthodontic treatment, or those suffering orofacial pain were excluded. Sample size was calculated considering a Type I error of 0.05, a power of 0.80 and a Pearson correlation between asymmetry of bite force and masticatory laterality of 0.40.[10] Subjects were fully informed and signed an informed consent form approved by the Ethics Committee of the Barcelona University Dental Hospital (Code 17/12). All experiments were carried out in accordance with the principles of the Helsinki Declaration.[25]

2.2. Masticatory assays

Each subject performed four different masticatory assays, each consisting of five trials of 20 cycles each chewing 2 g of silicon. Optosil tablets (5 mm thick, 20 mm diameter) (Optosil P Plus; Heraeus Kulzer, Hanau, Germany) were made as described by Albert et al.[15] and were cut into four quarters. Two types of chewing test food were used: three quarter tablets (2 g) without a bag (unbagged silicon) and three quarter tablets placed in a latex bag which was sealed with cyanoacrylate adhesive (bagged silicon).[19] Two assays consisted of free-style mastication: in one, subjects chewed the unbagged silicon test food and in the other, the bagged silicon, in order to assess the influence of the type of test food in the PCS, the MPS and the cycle duration. For the other two assays, subjects were asked to chew bagged silicon unilaterally, using only the right-hand side in one assay and only the left-hand side in the other. The order of the trials was alternated between unbagged and bagged chewing tests for free-style mastication and between right and left for unilateral mastication.

Masticatory performance was evaluated for each masticatory assay by assessing the degree of comminution of the silicon test food.[21,23] For each assay, particles from five trials (10 g) were dried for 24 h and passed through a series of eight sieves (0.25, 0.425, 0.85, 2, 2.8, 3.15, 4, and 5.6 mm) while being shaken for 1 min. After cumulative weight distribution of the sieve contents had been determined, median particle size was calculated for each subject using the Rosin–Rammler equation $[Q_w\ (X) = 1 - 2E - (X/X_{50})^b]$, where $Q_w\ (X)$ is the fraction of particles by weight with a diameter smaller than X, the median particle size (MPS or X_{50}) is the size of a theoretical sieve through which 50% of the weight can pass, and b describes the breadth of particle size distribution.[26] The total duration of each of the five trials was used to calculate the duration of the average chewing cycle.[27]

A video camera (Sony HDR-UX7E, Japan) recorded mandible displacement while closing during each free-style mastication assay. The side of mandible lateralisation while closing was counted for each chewing cycle using a slow-speed playback mode to calculate masticatory laterality. The asymmetry index (AI) for each free-style mastication of bagged or unbagged silicon, was calculated according to Mizumori et al.[17] as

$$AI = \frac{\text{number right strokes} - \text{number of left strokes}}{\text{number right strokes} - \text{number of left strokes}}$$

2.3. Data analysis

The side difference of masticatory performance was calculated as absolute difference between the MPS obtained chewing