RESEARCH PAPER

Influence Of Text Neck Posture On The Masticatory Muscle Activity During Mastication Of Different Textured Foods In Young Adults

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ABSTRACT

Background: This study investigated the influence of Text Neck Posture (TNP) on the bioelectrical activity of the superficial masseter and anterior temporalis muscles during mastication in young adults. The purpose was to compare the muscular effort between individuals with and without TNP while chewing two textured foods (soft bread and hard carrot) during mobile phone use. The principal conclusion is that TNP necessitates a compensatory physiological adjustment, leading to increased muscular effort during function.

Methods: A total of 140 young adults were categorized into Text Neck Posture (Craniovertebral Angle, CVA 35°–49°) and Non-TNP (≥50°) groups via 2D photogrammetry. Surface Electromyography (sEMG) was used to record the mean amplitude and duration of the masticatory muscles bilaterally while participants performed the chewing task. The ethical approval for undertaking the proposed study has been obtained from the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, vide their letter no. KVV/IEC/01/2025 dated January 23, 2025.

Results: The TNP group demonstrated a significantly higher mean EMG amplitude in the masseter muscle compared to the Non-TNP group for both soft (Right Masseter: 624.53 ± 161.92 µV vs 500.64 ± 101.95 µV; p = 0.0004) and hard foods (Left Masseter: 774.19 ± 171.4 µV vs 673.72 ± 144.25 µV; p = 0.0089). The Right Temporalis also showed a significant increase when chewing bread (556.47 ± 119.33 µV vs 505.93 ± 119.3 µV; p = 0.0449). Conversely, no significant differences were observed in the mean duration of muscular activity.

Conclusion: Text Neck Posture significantly increases the neuromuscular effort of the masticatory muscles. This heightened activation is interpreted as a compensatory muscular response necessary to maintain mandibular stability under the altered biomechanical stress of forward head posture. These findings emphasize the need for early postural awareness and ergonomic interventions.

Keywords: Text Neck Posture; Craniovertebral Angle; Masticatory Muscles; Electromyography; Superficial Masseter; Anterior Temporalis; Temporomandibular Joint Dysfunction; Digital Device Use.

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INTRODUCTION

In light of the significant uptick in the adoption of cutting-edge devices such as smartphones and tablets, no age group is exempt from technological influence. A study by Poonsri (2015) reveals that a considerable number (79%) of young adults (18-44 years old) are almost perpetually connected to their mobile phones, with only 2 hours daily spent without their device.[1] The old adage "excess of everything is bad"

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warns against immoderation, suggesting that overindulgence can lead to negative consequences. The inveterate usage of hand-held devices in recent decades has had deleterious effects on multiple dimensions of health, encompassing physical, mental, and emotional health.[2]

Regarding physical health, the most significant concern is the adverse alteration in posture. When using smartphones, individuals often flex their necks to view the screen, leading to excessive forward curvature of the lower neck (lordosis) and backward curvature of the upper back (kyphosis). This posture, often termed "text neck", can exert excessive stress on the cervical spine and neck muscles, potentially causing pain and dysfunction.[3,4] The cervical spine is seen to be in 15°-60° flexion.[5] As per Dr. Hansraj's research, which has been widely cited and recognized in the field of spinal health, the load impact on the spine and its segments is well influenced by the position of the head, which normally weighs 10-12 pounds in a neutral position, and as the angle of neck flexion increases there is a linear increase in the force impacting the spine.[6]

While 'turtle neck' or 'text neck' is different from 'desktop neck posture' or 'forward head posture' (FHP), in FHP, the head moves forward from its natural alignment with the cervical spine, typically accompanied by a backward tilt of the head and compensatory extension in the upper cervical spine. This posture adjustment is typically made in an effort to maintain a horizontal gaze, such as when looking at a computer screen or desktop. Some researchers have even coined the term "desktop neck posture" to describe this specific alignment. Text neck posture (TNP) is characterized by excessive flexion of the upper cervical spine. In this posture, the head is tilted forward, causing a downward gaze that fixates on the screen. This position places significant strain on the cervical region, as the individual maintains a sustained flexed position, with the eyes continuously focused downward on the device.[7]

The intricate relationship between the cervical spine and the temporomandibular joint (TMJ) is well-established. The biomechanical connection between the head, neck, and jaw is evident in the shared muscular attachments that influence the position and function of these structures. The primary and secondary muscles responsible for jaw movement also play a crucial role in stabilizing the cervical spine, particularly the atlanto-occipital joint. The resting position of the mandible is strongly reliant on the synchronized action of the posterior and anterior cervical spine muscles, as the mandible resides within this muscular network, and the balance of these muscles largely governs its positioning.[8,9]

The intricate network of muscles connecting the TMJ, cervical spine, and head underscores the importance of addressing postural imbalances to optimize oral health and overall well-being. Research indicates a strong correlation between craniocervical posture and temporomandibular joint dysfunction (TMD). Any deviation from optimal head and neck alignment can exert significant biomechanical stress on the masticatory muscles, compromising their function and potentially leading to TMD.[10]

Alterations in craniocervical posture can impact the range of motion of the temporomandibular joint, as well as the ornate occlusal relationship between the upper and lower teeth. Variations in head position have been found to modify masticatory muscle activity, affecting the mandible's vertical and horizontal positioning. The intricate network of muscles connecting the TMJ, cervical spine, and head underscores the importance of addressing postural imbalances to optimize oral health and overall well-being. These factors can collectively contribute to the development and progression of TMD, emphasizing the importance of maintaining proper head and neck posture for optimal oral health and function.[11,12]

Numerous scientific studies have contributed valuable information to this field of study related to the stomatognathic and cranio-cervical-mandibular systems. According to one study, the research demonstrated that with the head moving forward in relation to the spine's natural weight-bearing axis, there is a marked decrease in the vertical distance required for mandibular closure, or the physiological free space between the mandible and the maxillae decreases.[13]

Forward head posture (FHP) contributes to the forces exerted on the mandible by increasing the activity of the masticatory muscles responsible for lifting the mandible. This can also be influenced by the increased impact of gravity and the backward tilt of the cervical spine.[14]

In the late 20th century, a research paper corroborated the hypothesis that head position influences the activity of the temporomandibular joint musculature. Electromyographic (EMG) analysis demonstrated a significant increase in the electromyographic activity of the middle masseter and anterior digastric muscles during varied degrees of neck flexion. Conversely, neck extension led to the opposite pattern of muscle activity.[15]

Empirical evidence suggests that forward head posture is linked to increased activity in the temporal and masseter muscles, likely due to changes in the muscle-length tension relationship resulting from the altered mandibular position.[13,16] Extensive studies have been conducted on head and neck postures, primarily focusing on forward head posture, especially after the advent of the computer age and its pernicious effects on the spine and the craniofacial region.

We are now entering a new technological era, with smartphones and tablets, which have made us more addicted to screens, creating a pressing need to focus on their negative repercussions. Very few empirical studies have been conducted to assess the effects of text neck posture (TNP) on the stomatognathic and cranio-cervical-mandibular systems, and none have investigated its impact on the strength of the masticatory muscles or their role in the process of mastication.

This study aimed to address existing research gaps by: 1) measuring the bioelectrical activity of masticatory muscles in young adults with text neck posture using EMG while chewing soft and hard foods during mobile phone use; 2) measuring the same activity in young adults without text neck posture under similar conditions; and 3) comparing the differences in muscle activity between individuals with and without text neck posture.

It was hypothesized that the bioelectrical activity of the masticatory muscles during chewing, particularly when consuming foods of varying textures (hard and soft) and while simultaneously using a mobile phone, would exhibit significant differences in young adults with a text neck posture compared to their counterparts without this postural characteristic.

MATERIALS AND METHODS:

- *Study design-*
  This study followed a cross-sectional comparative design, evaluating neuromuscular activity in young adults with and without Text Neck Posture (TNP) during mastication of soft and hard foods. The design allowed simultaneous assessment of cervical posture status and corresponding EMG responses under standardized chewing conditions.
- *Sample size calculation-*
  The formula used to calculate the sample size for this research was **$n = {}^{2}pq/L2.$** Where "n" is the total sample size, Z = standard normal variant at 95% = 1.96, p = prevalence of text neck posture = 46%, q = 100 – 46= 54 and L = 5 (permissible limit of error). So the total sample size came to be about 150.

- *Participants-*

This study enrolled a total of 150 young adults between 18 and 30 years of age who were regular digital device users, spending at least four hours daily on their phones or tablets. Within this group, **87 were female** and **63 were male**. We ensured all participants were in good overall health, with no systemic illnesses that could affect their posture or muscle function, allowing us to focus specifically on the impact of their digital habits.

Individuals were systematically excluded if they presented with: a history of cervical spine injury, surgical intervention, or chronic neck pain unrelated to text neck posture; a diagnosis of neuromuscular disorders known to compromise postural control or masticatory muscle function; the presence of missing teeth or dental prostheses capable of altering normal masticatory biomechanics; or active periodontal disease or other oral health conditions affecting mastication.

Further exclusions included participants utilizing medications with known influence on muscle activity (e.g., muscle relaxants, antispasmodics), those exhibiting other significant postural deformities such as scoliosis or kyphosis, or individuals whose behavioural factors (e.g., inability to maintain stillness or specific postures during EMG analysis) or substance abuse history precluded reliable participation.

This rigorous selection methodology was implemented to enhance the internal validity of the study's findings. Out of 150 population, 10 didn't meet the inclusion criteria: 5 had undergone dental procedures, 3 were on antispasmodics, and the remaining 2 had a history of cervical injury, so the total participants included in this study were 140.

- *Postural Assessment-*

Craniovertebral Angle (CVA) was assessed using 2D photogrammetry, a precise and reliable postural evaluation method. Lateral images were captured with a smartphone camera, using reflective markers on anatomical landmarks, and analyzed with the Physiomaster app for standardized CVA measurement.[17] Participants with a CVA of 35°–49° were classified as having text neck posture, while those with ≥50° were classified as without. Of 140 participants, 71 had text neck posture and 69 did not.

- *sEMG Positioning and Measurement-*

Surface electromyography (sEMG) data were recorded from the superficial masseter and anterior temporalis muscles.[18] The sEMG was recorded using the **Octopus** system (Hardware Ver 2.80, Software Ver 5.05) manufactured by **Clarity Medical Private Limited**. **Ag/AgCl surface electrodes** were utilized. The investigators were not blinded to the participants' posture classification (TNP or Non-TNP), which is an acknowledged limitation of the study design. Before electrode placement, the skin was cleansed with wet wipes to reduce impedance, and participants with facial hair were excluded. Electrode placement followed SENIAM guidelines, ensuring alignment parallel to muscle fibers for optimal signal capture. Electrodes were positioned over the muscle belly, aligned parallel to muscle fibers, with a 2 cm inter-electrode distance. Muscle locations were identified using the verbal prompt "Bite and relax," and electrode sites were marked before application. The masseter electrode was placed over the midpoint between the mandibular angle and the zygomatic arch, while the anterior temporalis electrode was positioned above the zygomatic process along the temporal fossa. A ground electrode was placed on the frontal bone.

EMG settings included a sweep speed of 300 ms/division, a high-pass filter of 30 Hz, a low-pass filter of 500 Hz, and a sensitivity of 200 µV. A notable limitation was the utilization of a single-channel sEMG device, which required each muscle to be tested individually. Specifically, the right and left sides of the masseter and temporalis muscles were measured sequentially, rather than simultaneously. Furthermore, participants were not randomized into the TNP and Non-TNP groups, as group allocation was based on the Craniovertebral Angle (CVA) measurement, a natural postural characteristic.

Participants were comfortably seated and asked to play Subway Surfers on their phones to simulate a text neck posture. While playing, they chewed a slice of crust-free white bread, and mean amplitude and chewing cycle duration were recorded over 15 seconds. After rinsing, the procedure was repeated with a piece of carrot representing a hard-textured food. Muscle activity was measured separately for each food type on one side before testing the opposite side.

RESULTS:

- *Demographic data-*

The gender distribution among participants indicates that **59% were female** and 41**% were male** (Figure 1). Participants were primarily in the age ranges of **20–21 years (53%)** and **22–23 years (44%)**, with only **3%** in the **18–19 age group**. (Figure 2)

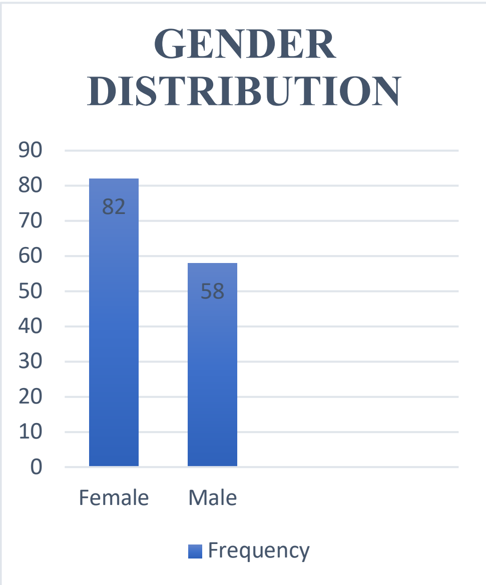

Figure 1. Gender distribution graph.

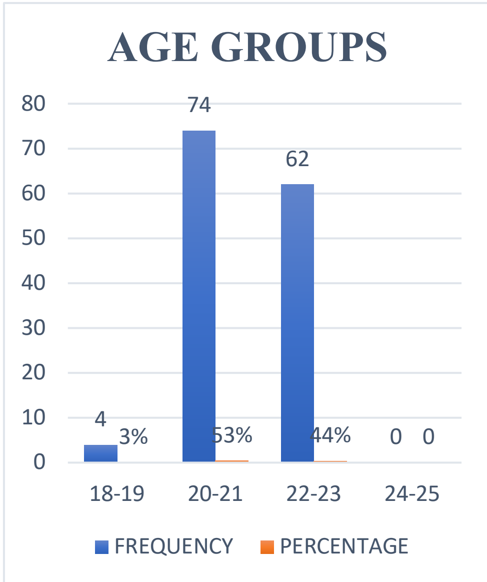

Figure 2. Age distribution graph.

Most of the subjects reported heavy daily usage of mobiles. That is, 4% of them used their phones for 8 hours a day, 22% for 7 hours, 36% for 6 hours, 31% for 5 hours, and 7% for 4 hours (Figure 3). These results suggest a high prevalence of mobile usage in the sample, making it essential to study posture-related musculoskeletal impacts in this group. Among mobile phone brands, **43% of participants used Apple**, followed by **Samsung (27%)** and **OnePlus (14%)**. Other brands used included **Oppo (7%)**, **Xiaomi (6%)**, and **Vivo (2%)** (Figure 4).

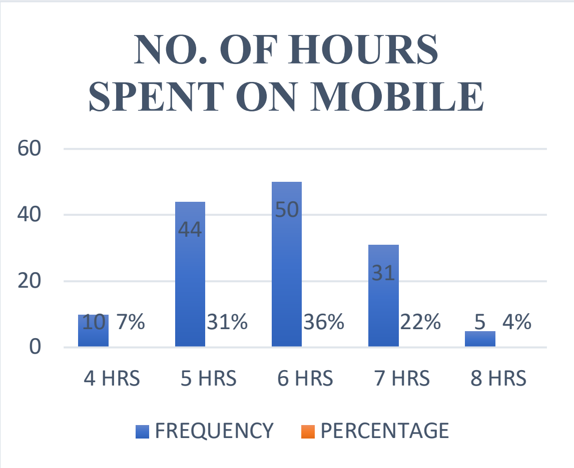

Figure 3. Number of hours spent on mobile.

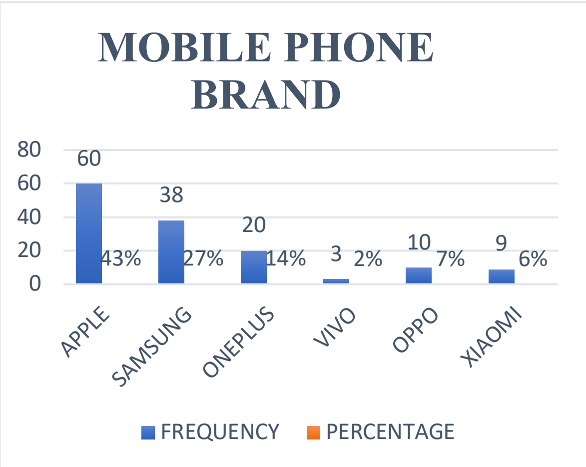

Figure 4. Mobile phone brand used.

Table 1. The percentage of the population adopting different postures while using their phones, and the percentage of the population wearing glasses.

		WITH TNP (71)	WITHOUT TNP (69)
POSTURE	Sitting (%)	28%	28%
	Lying (%)	41%	39%
	Slouched posture (%)	31%	33%
GLASS WEARERS	No (%)	70%	84%
	Yes (%)	30%	16%
	No. of people wearing the prescribed glasses during phone usage (%)	29%	27%
	No. of people not wearing the prescribed glasses during phone usage (%)	71%	72.8%

- *Statistical analysis-*
  Before applying parametric tests, data were assessed for normality using the **Shapiro–Wilk test**, which confirmed that amplitude and duration values followed a normal distribution ($p > 0.05$). Homogeneity of variances between TNP and non-TNP groups was verified using **Levene's Test**, with results indicating non-significant variance differences for all muscle variables ($p > 0.05$). Therefore, independent t-tests were deemed appropriate for group comparisons.
  Normality and variance checks confirmed the suitability of parametric testing. Group comparisons revealed consistently higher EMG amplitudes in the TNP group across most chewing conditions, whereas activity duration showed no significant group differences.

- *sEMG Recording Analysis-*

Participants were divided into two groups based on their CVA: those exhibiting TNP and those without TNP. The statistical evaluation performed on the gathered data concerning the mean amplitude and mean duration of both the masseter and temporalis muscles on each side during the chewing of various textured food items used an independent sample t-test, which is suitable for comparing the means of two separate groups. A p-value of less than 0.05 was deemed statistically significant.

Rt MASSETER	BREAD [MEAN AMPLITUDE]		BREAD [MEAN DURATION]		CARROT [MEAN AMPLITUDE]		CARROT [MEAN DURATION]	
MEAN ± SD	WITH TNP = 624.53 ± 161.92	WITHOUT TNP = 500.64 ± 101.95	WITH TNP = 5.99 ± 0.8214	WITHOUT TNP = 6.011 ± 0.7159	WITH TNP = 846.03 ± 483.46	WITHOUT TNP = 623.91 ± 159.8	WITH TNP = 6.77 ± 0.95	WITHOUT TNP = 6.37 ± 0.75
P VALUE	0.0004		0.9096		0.0241		0.0539	
t VALUE	3.646		0.1139		2.292		1.951	
SIGNIFICANCE	EXTREMELY SIGNIFICANT		NOT SIGNIFICANT		SIGNIFICANT		NOT SIGNIFICANT	

Table 2- Comparison of Mean Amplitude (µV) and Duration (ms) of Right Masseter Muscle Activity between Text Neck Posture and Non-Text Neck Posture Groups During Chewing of Soft and Hard Foods.

TABLE 2 INTERPRETATION:

On mastication of bread, TNP patients showed significantly higher mean EMG amplitude (624.53 ± 161.92 µV) compared to their non-TNP counterparts (500.64 ± 101.95 µV) with a p-value of 0.0004, indicating an extremely significant increase in the level of muscle activation. This indicates more neuromuscular effort being demanded by TNP even in the mastication of soft food. However, the duration of muscular activity did not show any significant difference (p = 0.9096). On mastication of carrots, amplitude was also significantly higher in the TNP group (846.03 ± 483.46 µV) compared to the non-TNP group (623.91 ± 159.8 µV) with a p-value of 0.0241. While the duration, although not statistically signficant (p = 0.0539), was close to significance.

Lt MASSETER	BREAD [MEAN AMPLITUDE]		BREAD [MEAN DURATION]		CARROT [MEAN AMPLITUDE]		CARROT [MEAN DURATION]	
MEAN ± SD	WITH TNP = 605.73 ± 105.54	WITHOUT TNP = 543.85 ± 120.67	WITH TNP = 6.03 ± 0.75	WITHOUT TNP = 5.75 ± 0.77	WITH TNP = 774.19 ± 171.4	WITHOUT TNP = 673.72 ± 144.25	WITH TNP = 6.44 ± 0.865	WITHOUT TNP = 6.3 ± 0.95
P VALUE	0.0152		0.1144		0.0089		0.4759	
t VALUE	2.472		1.593		2.669		0.7157	
SIGNIFICANCE	SIGNIFICANT		NOT SIGNIFICANT		VERY SIGNIFICANT		NOT SIGNIFICANT	

Table 3- Comparison of Mean Amplitude (µV) and Duration (ms) of Left Masseter Muscle Activity between Text Neck Posture and Non-Text Neck Posture Groups During Chewing of Soft and Hard Foods.

TABLE 3 INTERPRETATION:

For the left masseter, TNP group bread mastication had much higher amplitude (605.73 ± 105.54 µV) than the non-TNP group (543.85 ± 120.67 µV), with p = 0.0152. Duration was not significantly different (p = 0.1144). Carrot mastication produced much higher amplitudes in TNP subjects (774.19 ± 171.4 µV) than controls (673.72 ± 144.25 µV), with p = 0.0089, reflecting increased strain on this muscle to accomplish harder mastication tasks. Duration differences were not significant (p = 0.4759).

Rt TEMPORALIS	BREAD [MEAN AMPLITUDE]		BREAD [MEAN DURATION]		CARROT [MEAN AMPLITUDE]		CARROT [MEAN DURATION]	
MEAN ± SD	WITH TNP = 556.47 ± 119.33	WITHOUT TNP = 505.93 ± 119.3	WITH TNP = 5.81 ± 0.91	WITHOUT TNP = 6.01 ± 0.64	WITH TNP 684.191 ± 160.8	WITHOUT TNP = 602.64 ± 129.37	WITH TNP = 6.72 ± 0.811	WITHOUT TNP = 6.61 ± 0.98
P VALUE	0.0449		0.2947		0.022		0.6072	
t VALUE	2.032		1.054		2.328		0.5157	
SIGNIFICANCE	SIGNIFICANT		NOT SIGNIFICANT		NOT SIGNIFICANT		NOT SIGNIFICANT	

Table 4- Comparison of Mean Amplitude (µV) and Duration (ms) of Right Temporalis Muscle Activity between Text Neck Posture and Non-Text Neck Posture Groups During Chewing of Soft and Hard Foods.

TABLE 4 INTERPRETATIONS:
The right temporalis muscle exhibited a high amplitude difference while chewing bread in TNP subjects (556.47 ± 119.33 µV) compared to non-TNP subjects (505.93 ± 119.3 µV), with p = 0.0449. The difference was not significant in duration (p = 0.2947). In the case of the carrot, while the amplitude was greater in the TNP group (684.19 ± 160.8 µV), the difference was reported as not statistically significant (p = 0.022). Duration was again not significant (p = 0.6072).

Lt TEMPORALIS	BREAD [MEAN AMPLITUDE]		BREAD [MEAN DURATION]		CARROT [MEAN AMPLITUDE]		CARROT [MEAN DURATION]	
MEAN ± SD	WITH TNP = 594.51 ± 113.46	WITHOUT TNP = 548.196 ± 92.05	WITH TNP = 5.91 ± 0.58	WITHOUT TNP = 6.14 ± 1.05	WITH TNP = 692.73 ± 148.16	WITHOUT TNP = 610.06 ± 104.68	WITH TNP = 6.67 ± 0.85	WITHOUT TNP = 6.45 ± 0.73
P VALUE	0.0643		0.1707		0.01303		0.241	
t VALUE	1.872		1.38		2.618		1.18	
SIGNIFICANCE	NOT QUITE SIGNIFICANT		NOT SIGNIFICANT		SIGNIFICANT		SIGNIFICANT	

Table 5- Comparison of Mean Amplitude (µV) and Duration (ms) of Left Temporalis Muscle Activity between Text Neck Posture and Non-Text Neck Posture Groups During Chewing of Soft and Hard Foods.

TABLE 5 INTERPRETATION:
Bread chewing elicited a somewhat greater amplitude in the TNP group (594.51 ± 113.46 µV) than in the non-TNP (548.20 ± 92.05 µV), albeit the difference was not significant (p = 0.0643). Duration was not statistically different (p = 0.1707). For carrot chewing, the amplitude was significantly greater in TNP subjects (692.73 ± 148.16 µV) compared to non-TNP subjects (610.06 ± 104.68 µV) with p = 0.01303. Duration differences were not significant (p = 0.241), although the figure indicates a slight trend towards greater activation time.

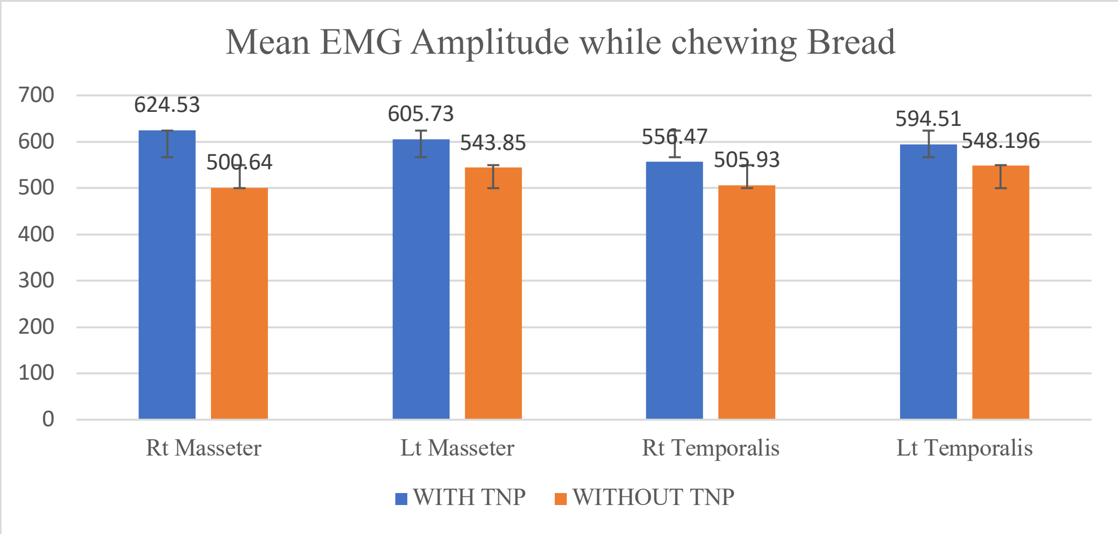

Figure 5. Mean EMG Amplitude while chewing Bread.

Mean EMG amplitude (µV) of masticatory muscles during mastication of bread. Bar chart comparing mean amplitudes (mean ± SD) between participants with Text Neck Posture (TNP) and Non-TNP groups for right and left masseter and temporalis muscles. Error bars represent ±1 standard deviation (Figure 5).

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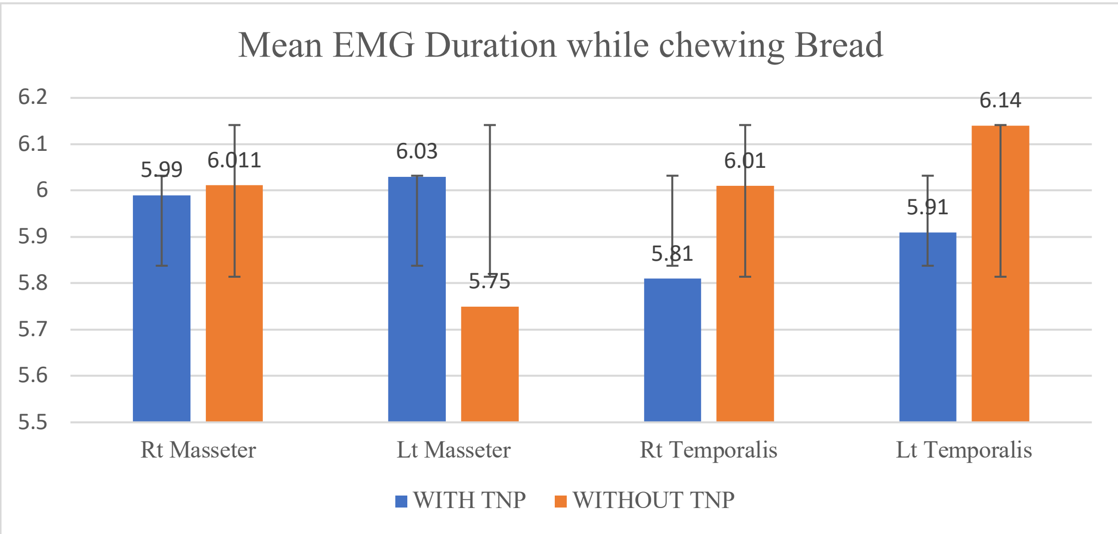

Figure 6. Mean EMG Duration while chewing Bread.

Mean EMG duration (ms) of masticatory muscles during mastication of bread. Bar chart comparing mean duration (mean ± SD) between participants with Text Neck Posture (TNP) and Non-TNP groups for right and left masseter and temporalis muscles. Error bars represent ±1 standard deviation (Figure 6).

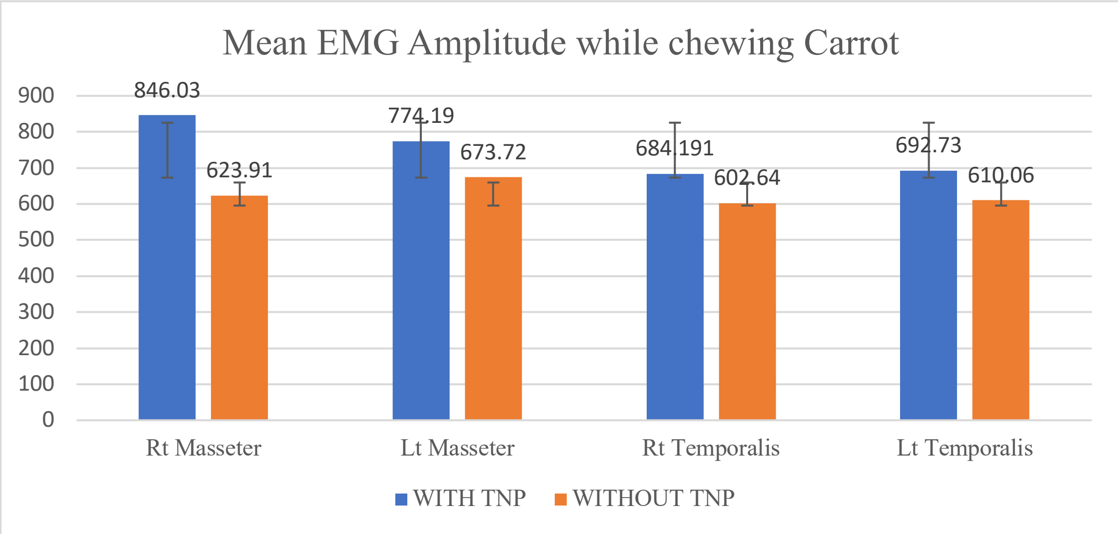

Figure 7. Mean EMG Amplitude while chewing a carrot.

Mean EMG amplitude (µV) of masticatory muscles during mastication of a carrot. Bar chart comparing mean amplitudes (mean ± SD) between participants with Text Neck Posture (TNP) and Non-TNP groups for right and left masseter and temporalis muscles. Error bars represent ±1 standard deviation (Figure 7).

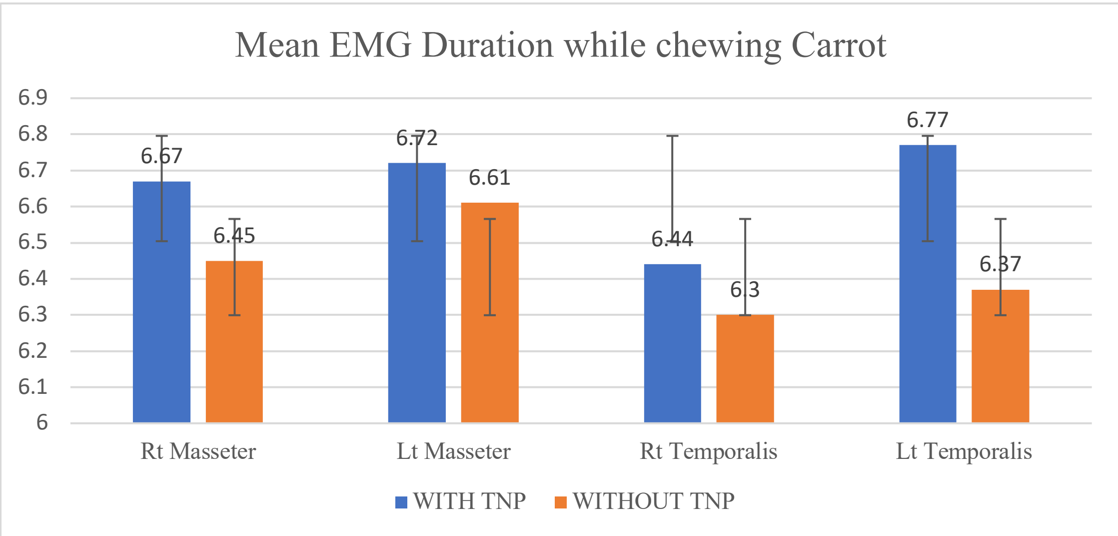

Figure 8. Mean EMG Duration while chewing a carrot.

Mean EMG duration (ms) of masticatory muscles during mastication of a carrot. Bar chart comparing mean duration (mean ± SD) between participants with Text Neck Posture (TNP) and Non-TNP groups for right and left masseter and temporalis muscles. Error bars represent ±1 standard deviation (Figure 8).

DISCUSSION:

This research examined the impact of text neck posture on the electrical activity of masticatory muscles, specifically the superficial masseter and anterior temporalis on both sides, while mastication in young adults, contrasting those with text neck posture and those without. The findings indicate that individuals with text neck posture exhibit increased muscle activity during chewing. This was particularly evident in the masseter muscle on both sides, which demonstrated a higher mean amplitude between the

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groups. Muscle activity rose while chewing both of the specified textured foods (bread and carrot). These results emphasize that excessive cervical flexion adds extra strain on the masseter, an important muscle for elevating the mandible, thereby necessitating greater muscle effort during chewing movements.

In both groups, the activation of the masseter muscle was noticeably greater while chewing carrots compared to chewing bread (Rt masseter p value= 0.041, Lt masseter p value= 0.0089), suggesting that more challenging chewing tasks place a greater functional demand on this muscle. The temporalis muscle also shows increased activity under certain conditions, although this increase is less consistent than that of the masseter; in some instances, the activity during bread chewing was greater, while in others it was higher for carrots, but neither of these differences reached statistical significance. The lack of significant differences in muscle activity time between the groups suggests that individuals with TNP and those without chewed for approximately the same amount of time, suggesting that the timing aspects of mastication remain quite consistent regardless of posture. Since these timing parameters were not different, it suggests that TNP does not influence the amount of time spent chewing, but the degree of muscular effort during that time of mastication. The increased muscular amplitude seen may be due to increased tonic contraction or increased force generation in the TNP individuals.

A vast body of research exists around the interrelation of the stomatognathic system and the cranio-cervico-mandibular system, such as empirical research that demonstrates how the myoelectric activity of masticatory muscles varies as cranio-cervical alignment varies. Even minor deviations from the normal head position have a direct impact on the functioning of muscles to accommodate such deviations, as demonstrated through studies that show the impact of body posture on occlusal characteristics and force.[19] Another cause of variation in muscle activity is the principle known as the "length-tension relationship."

This fundamental physiological principle holds that muscle fibres produce their maximum isometric force at their optimal resting length. Any deviation from this optimal length, whether from over-shortening or over-elongation, reduces the capacity of the muscle to contract effectively because the actin and myosin filaments do not overlap optimally. The muscle must therefore demonstrate greater bioelectrical activity—either in the form of increased firing frequency or increased recruitment of motor units—to produce a force.[20,21]

In relation to text neck posture (TNP), characterized by prolonged cervical flexion, there is a significant shortening of the deep neck flexors and an excessive lengthening of the cervical extensors, frequently accompanied by compensatory activation of the upper thoracic muscles. These muscular imbalances lead to changes in activation patterns not only in the cervical area but also in interconnected systems like the masticatory apparatus, being a part of a kinetic chain.[19]

This research explored how these altered positions affected not just the muscle function but also the chewing process, along with how the changes in positioning impacted muscle activity while eating both a soft food item and a harder one, and since there were two groups already segregated based on their postures, it was easy to compare the differences and test the hypothesis. Typically, it is noted that, in comparison to the temporalis muscle, the masseter muscle plays a more significant role during chewing in individuals with normal function.[22,23]

One particular study indicated that the temporalis was utilized slightly more than the masseter during maximum forward head posture due to a more posterior condylar placement.[24,25] When the mandibular condyle is displaced posteriorly within the fossa, as seen in FHP, the anterior fibres of the temporalis muscle are positioned at a suboptimal length, specifically shorter than their physiological resting state.[26] This compromised position hinders the ideal sarcomere overlap, consequently reducing the muscle's efficiency in generating force. To overcome this biomechanical disadvantage and preserve mandibular stability, the neuromuscular system must activate additional motor units. This recruitment is reflected in heightened electromyographic activity and an increased amplitude of muscle activation, even during periods of rest or light occlusal contact. Thus, a posterior condylar position frequently correlates with hyperactivity and increased amplitude in the anterior temporalis muscle.[27,28] However, this was not deemed significantly relevant to text neck posture in the current study.

These results are consistent with current literature, which states that any deviation from normal head posture can create imbalances in the cervical and craniofacial musculature. Such imbalances may predispose individuals to myofascial pain, temporomandibular dysfunction, and neuromuscular fatigue if not properly identified and addressed.[29]

The research also revealed a notable and particular connection: an affirmative link between phone weight and the average amplitude of muscle activity in the right temporalis and masseter muscles. This effect occurred solely when chewing the hard food (carrots) and was not present while chewing bread. This result indicates a biomechanical relationship in which the stationary weight of a heavier phone, along with the considerable dynamic force needed to chew tough food, requires an adjusted rise in single-sided masticatory muscle exertion. Studies show that the craniomandibular system (comprising the head, jaw, and neck structures) and the postural control system are closely interconnected as they form a kinetic chain allowing force transmission from the distal segments of the upper limb up to the mandible and vice versa. When someone holds a heavy item, their central nervous system triggers a broad "bracing" reaction to preserve balance and stability.[30,31] This isn't restricted to the arms and back; it also involves the neck and jaw muscles. The restriction of this effect to the right side could suggest a compensatory reaction from the dominant side to handle the combined stress from the weight of the phone and the chewing challenge.

This study, however, discovered no notable positive correlation between the hours dedicated to phone use and the average amplitudes of the masticatory muscles. This indicates that the connection between smartphone usage and jaw muscle activity is not a straightforward linear function of the time spent on screens. Rather, it is probably affected by the quality of the user's posture, which can differ significantly throughout the day, regardless of length. Previous research and the limitations of our study indicate that a person's posture when using a phone can vary widely, including sitting and lying down. These varying postures might inhibit the establishment of a direct link, as the physiological stress on the cranio-cervico-mandibular system relies more on particular ergonomic discrepancies than on the total duration of device usage.

Ultimately, no notable correlation was found between the use of glasses and the average amplitudes of the masticatory muscles on both sides. The lack of a clear link is likely due to inconsistencies in spectacle wear among the participants. Many individuals who are prescribed glasses do not wear them consistently, particularly during prolonged periods of phone use, as their prescription may be primarily for distance vision. Furthermore, some users opt against wearing their glasses for extended periods if their optical correction is minor. These varying habits regarding spectacle use likely diluted any potential correlations between visual aids and masticatory muscle activity. This finding disputes the theory that using glasses could encourage a more straight head position, thus decreasing the requirement for compensatory muscle activity in the jaw. The absence of a statistically significant finding suggests that any potential postural benefits from wearing glasses are not substantial enough to create a measurable change in muscle activity during the dynamic process of chewing. The chewing of both hard and soft foods is a demanding and forceful action, and it appears that the biomechanical requirements of mastication itself are the primary determinant of muscle amplitude, effectively overshadowing any subtle changes in head posture induced by visual aids.

In summation, the primary finding of significantly elevated EMG amplitudes in participants with Text Neck Posture (TNP) confirms that forward cervical flexion substantially disrupts the biomechanical equilibrium of the cranio-cervico-mandibular system. This postural imbalance necessitates a greater degree of compensatory neuromuscular effort to stabilize the mandible during functional tasks like mastication. This chronic muscular overactivation is not merely a physiological adaptation but a clinically relevant factor that may predispose individuals to masticatory muscle fatigue, chronic cervico-mandibular pain syndromes, and the development of Temporomandibular Dysfunction (TMD). These data underscore the critical interdependence of neck posture and jaw function, cementing the substantial clinical relevance of this study for guiding early postural awareness and ergonomic interventions in preventive and rehabilitative practices.

CONCLUSION:

This study establishes that text neck posture exerts a significant influence on the bioelectrical activity of the masticatory muscles during mastication. Individuals exhibiting text neck posture demonstrated notably higher EMG amplitudes, particularly in the masseter muscle, indicating increased neuromuscular effort to maintain mandibular function under altered cervical alignment. Although the duration of muscle activity remained comparable between groups, the elevated amplitude underscores compensatory adaptations within the cranio-cervico-mandibular system. These findings emphasize the biomechanical interdependence between cervical posture and masticatory function and underscore the need for early postural awareness and ergonomic interventions to mitigate potential musculoskeletal strain. Future research should explore longitudinal effects, assess rehabilitation strategies targeting postural correction, and incorporate advanced kinematic analyses to further delineate the underlying neuromuscular mechanisms.

LIMITATIONS:

Several limitations were noted throughout the study, beginning with the observation that individuals assume different postures when using their phones, often straying from the typical sitting position with a straight back and knees and hips at 90° in a comfortable chair. More frequently, users are seen lying down, either on their sides or with their backs supported, with their legs crossed or spread apart; alternatively, those who are seated may tend to hunch forward or lean over a table in front of them. This presents a fresh viewpoint on the idea of text neck posture. It is plausible that these types of improper postures have played a role in the variations noted in the CVA. A second limitation encountered during the study was the lack of bilateral surface electrodes for EMG recording, which restricted the recordings to a unilateral and sequential method rather than a simultaneous bilateral assessment, thereby reducing the ability to evaluate asymmetry. This created an issue and may also account for some discrepancies in the results obtained. The study was also limited by the absence of blinding and lack of randomization in the sequence of measurements or food textures, which may have introduced procedural bias. The narrow age range (18–30 years) restricts generalizability to older adults or paediatric populations, where postural deviations and muscle behaviour may differ.

STRENGTH OF THE STUDY:

This study is one of the few to assess masticatory muscle activity during actual smartphone use, providing high ecological validity. The use of validated CVA measurement, objective EMG assessment, and comparison across two food textures strengthens the reliability and clinical relevance of the findings.

RECOMMENDATIONS:

Future studies should incorporate simultaneous bilateral EMG recordings, randomized testing sequences, and larger, more diverse age groups. Longitudinal research examining chronic effects of TNP on TMJ load, cervical stability, and chewing biomechanics is recommended. Interventional studies should assess whether corrective neck-posture training, ergonomic modifications, or targeted cervical-mandibular exercises can normalize masticatory muscle activity.

ETHICS STATEMENT:

The study received approval from the Institutional Ethical Committee of Krishna Vishwa Vidyapeeth, Karad (Protocol Number 349/2024-2025).

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CONFLICT OF INTEREST:

The authors declare that they have no conflicts of interest related to this article.

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