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Muscle Activation Dynamics during Karnapidasana Performance in Trained Yoga Male Subjects: An Electromyographical Analysis

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Abstract

Background: Electromyography (EMG) was utilized to investigate muscle activation dynamics of the sternocleidomastoid (SCM) muscle during karnapidasana, an advanced yoga posture involving deep spinal and cervical flexion. **Methodology:** This study involved eight trained male yoga students performing karnapidasana while EMG signals were recorded to analysed the SCM activation at specified intervals (i.e., 0 second, 10 seconds, 20 seconds, and 30 seconds). **Results:** Statistical analysis of data were exhibited the relatively stable mean EMG activation values across these intervals with no statistically significant differences ($p = 0.892$) which were indicated sustained and consistent engagement of the SCM muscle throughout the posture. **Findings:** These findings were highlighted the SCM's crucial role in maintaining neck stabilization during of karnapidasana performance. The stability of EMG activity supports the asana’s reported benefits in improving neck muscular strength, spinal flexibility, and neuromuscular control. **Conclusion:** This study provides neuromuscular evidence that substantiates karnapidasana’s therapeutic potential in rehabilitation, particularly for conditions involving cervical dysfunction and postural management.

Keywords: Electromyographical, Analysis, Posture, Muscle Activity and Sternocleidomastoid

Introduction

Electromyography (EMG) serves as a valuable tool in understanding neuromuscular mechanisms underlying yoga asanas, particularly in documenting the activation, coordination, and relaxation of key muscle groups during complex postures. Yoga practices are increasingly incorporated into rehabilitation programs due to their potential for improving musculoskeletal health, reducing pain, and enhancing neuromuscular control. EMG-based studies provide objective evidence to support the therapeutic application of yoga by identifying which muscles are most engaged during specific asanas, thereby clarifying their clinical utility in targeted rehabilitation strategies (Bhatia et al., 2007; Nambi & Shah, 2013; Rathore et al., 2017). Karnapidasana (Ear Pressure Pose) is an advanced forward-bending and inversion posture that combines deep spinal flexion with progressive trunk compression and cervical flexion. Its performance requires activation of anterior trunk muscles for flexion and stabilization, while simultaneously relaxing and lengthening posterior chain musculature. Clinically, this asana has implications for improving spinal mobility, abdominal muscle strength, cervical control, and posterior chain flexibility, all of which are relevant in the management of musculoskeletal disorders and postural dysfunctions. From a neuromuscular perspective, the sternocleidomastoid (SCM) plays a critical role in cervical flexion and head positioning, functions that are challenged in Karnapidasana due to the forward placement of the knees near the ears. Overactivation or weakness of SCM is often associated with tension-type headaches and cervical musculoskeletal disorders, and EMG analysis during this asana could provide insight into safe levels of muscle recruitment. The rectus abdominis is essential for trunk flexion and stability in the compressed position, making it highly relevant for rehabilitation of postural weakness, core instability, and metabolic or spinal conditions requiring abdominal strengthening. The erector spinae, typically responsible for spinal extension, is required to undergo controlled eccentric relaxation during deep trunk flexion, an adaptation that may be useful in managing low back stiffness and promoting spinal flexibility. Finally, posterior chain muscles, including the hamstrings and paraspinals, undergo active lengthening and relaxation during Karnapidasana, offering clinical benefits in reducing muscle tightness, correcting faulty posture related to sedentary lifestyle, and alleviating musculoskeletal pain syndromes.The progressive recognition of yoga's potential therapeutic benefits and its increasing integration into health sciences research (Sharma et al., 2025). Despite the recognized therapeutic potential of this asana, there remains limited EMG research documenting the muscle patterns engaged during its performance. A systematic exploration focusing on the SCM, rectus abdominis, erector spinae, and posterior chain muscles can provide clinically relevant insights into the neuromuscular demands of Karnapidasana. Such evidence could enhance prescriptive yoga therapy, allowing clinicians and physiotherapists to tailor interventions for conditions such as chronic low back pain, tension-type headache, cervical dysfunction, and postural disorders.

The present study aims to investigate EMG patterns of sternocleidomastoid muscles during karnapidasana performance with the goal of clarifying their functional roles and establishing an evidence-based rationale for the safe and effective clinical integration of this asana in rehabilitation contexts.

Methodology

Purpose: To determine the EMG muscle activation dynamics of sternocleidomastoid muscle during karnapidasana performance at different time intervals.

Design: Cross-sectional

Sample: Eight healthy as well as injury-free university yoga trained male subjects were selected after giving written informed consent and receiving ethical clearance and the mean age 20.37 years.

Instrumentation: A Biolite 4-channel EMG system was used to recorded the muscle activation of sternocleidomastoid muscle at specified time intervals (i.e., 0 second, 10 seconds, 20 seconds, and 30 seconds) in micro-volts nearest to the 0.001 micro-volts for surface electromyographical analysis.

Electrode Application: Electrode sites were prepped with alcohol and shaving. Disposable electrodes were placed over the muscle belly, with verification confirmed using neurostimulation and manual muscle testing.

Maximum Voluntary Isometric Contractions (MVICs): The study began with male subjects performing 30-second MVICs of the target muscles to obtain baseline data. EMG data were recorded continuously at different time intervals.

Task: Karnapidasana

Data Acquisition: Subjects were performed the posture for three successive trials. The EMG signals was continuously recorded for the initiation, holding, and release phases of the posture.

Analysis Selection: Data from the third trial was retained for final analysis, with ≤120 seconds of rest given between all trials to prevent fatigue.

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Intervals of Time in Seconds

Time	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
0sec.	8	32798.50	55.04	19.46	32755.33	32922.67
10sec.	8	32663.25	1062.69	375.72	30194.00	33707.67
20sec.	8	32580.00	319.38	112.91	32069.67	32869.67
30sec.	8	32704.25	234.91	83.05	32205.00	33035.00
Total	32	32686.50	545.50	96.43	30194.00	33707.67

Table No. 1.1 reveals a descriptive statistical analysis of the electromyographical (EMG) activity of the sternocleidomastoid muscle during the performance of karnapidasana by the selected male subjects which were recorded at four different time intervals (i.e., 0 second, 10 seconds, 20 seconds, and 30 seconds). Further, the sternocleidomastoid muscle was exhibited a mean EMG activation of 32,798.50 µV with a standard deviation (SD) of 55.05 µV and a standard error of the mean (SEM) of 19.46 µV at 0-second. These activation values were ranged from 32,755.33 µV to 32,922.67 µV which indicates the stable engagement at the initial stage of the posture. Furthur, at 10 seconds, the mean EMG value slightly declined to 32,663.25 µV, but the SD increased significantly to 1,062.70 µV (SEM = 375.72 µV) with a broader range from 30,194.00 µV to 33,707.67 µV, suggesting greater variability in muscle activation during this phase. Moreover, at the 20-second mark, the mean activation reduced further to 32,580.00 µV (SD = 319.38 µV, SEM = 112.92 µV) with a range between 32,069.67 µV and 32,869.67 µV, showing moderate stabilization of EMG activity. At 30 seconds, the Sternocleidomastoid exhibited a slight increase in muscle activation with a mean of 32,704.25 µV (SD = 234.91 µV, SEM = 83.05 µV) and values ranging from 32,205.00 µV to 33,035.00 µV.

Table No. 1.2 One-way-ANOVA of Electromyographical Analysis of Sternocleidomastoid Muscles Activation during Karnapidasana Performance in Selected Male Subjects

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	197934.997	3	65978.332	0.205	0.892
Within Groups	9026834.353	28	322386.941		
Total	9224769.350	31			

Table No. 1.2 indicates the results of the one-way analysis of variance which was conducted to determine the electromyographical (EMG) activity of the sternocleidomastoid muscle during the performance of karnapidasana among the selected male subjects across different time intervals. Further, the analysis was revealed a between-groups sum of squares and mean square i.e., 197,934.997 and 65,978.332 respectively and the degrees of freedom (df) was 3. The within-groups sum of squares was considerably higher at 9,026,834.353 with 28 df and mean square was 322,386.941 respectively. The total sum of squares obtained value was 9,224,769.350 and degree of freedom was 31. The calculated F-value was 0.205 and the level of significance was 0.892 which indicates that there were no statistically significant differences in sternocleidomastoid muscle activation among the recorded specific time intervals during karnapidasana performance.

Discussion

The electromyographical (EMG) analysis of the sternocleidomastoid (SCM) muscle activation during karnapidasana performance reported no significant variance in muscle activation between the four measured time intervals (i.e., 0 second, 10 seconds, 20 seconds, and 30 seconds). The descriptive statistics analysis was indicated a relative stable mean EMG value around 32,580 µV to 32,800 µV with some variability seen at 10 seconds due to a higher standard deviation. The increased variability at 10 seconds was suggested the minor adjustments or variations in muscle engagement during the transitional phase of the posture which stabilizes thereafter. The data analysis of one-way-anova was reported that obtained F-value was 0.205 and the (level of significance, p = 0.892) confirming no statistically significant differences in sternocleidomastoid muscle activation at different time points. This implies that the sternocleidomastoid muscle maintains a consistent level of activation throughout the karnapidasana posture which was reflecting that the muscle's sustained a role in cervical stabilization and engagement during this yoga asana posture. Similar findings were confirmed by Choi et al., 2021 that the sternocleidomastoid muscle plays a critical role in head and neck stabilization during postural tasks. Moreover, karnapidasana also requires a significant neck flexion and stabilization of sternocleidomastoid muscle as the legs are brought over the head which enables the consistent sternocleidomastoid muscle activation during stable final posture hold. Barbero et. al., 2012 and Netto & Burnett, 2006 also reported the similar findings of consistent activation without significant fatigue and variation aligns from their neuromuscular studies that electromyographic activity during tasks the muscle activation recruitment patterns in isometric contractions maintain stable muscle activations for postural control. Further, Kaminoff & Matthews (2011) also explained in "Yoga Anatomy" that insignificant fluctuations in muscle activation indicates about the muscle ability to sustain the load and the mechanical demands of inversion posture control without an excessive strain or fatigue which are essential for safe and effective practice. Furthermore, the stability in sternocleidomastoid activation during karnapidasana also demonstrates the posture associated benefits in improving neck and spinal flexibility while maintaining neuromuscular control.

Conclusion

The findings of the present study were indicated that sternocleidomastoid muscle demonstrated the consistent muscle activation throughout the duration of different time intervals during karnapidasana performance in trained male subjects with no statistically significant changes among the recorded at specific time intervals. Further, this stability in EMG activities were also suggested the muscle's vital role in maintaining neck stabilization during this yoga posture control. Thus, it is concluded that karnapidasana posture practice is performed for steady engagement of the sternocleidomastoid muscle for improving neck muscular strength and postural control without undue muscle fatigue in males.

Future Application: Present study outcomes were advocates about that regular practice of karnapidasana may contribute to improved proprioceptive awareness, neck stability, and postural control, supporting its relevance for both therapeutic and training applications.

Contribution: All authors contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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