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Early Spondylotic Changes in Cervical Spine Due to Weight Lifting on Head in Al-Muthanna Governorate

Usama Jabbar Hawala*, Bashar Adnan Munshid and
Ali Shahad Safi

Abstract--- Objective: *assess the relation between cervical spine degeneration and extrinsic axial load from weights overhead lifting.*

Methods: *Cross-sectional study of sixty patients (all of them were a females) between 18 to 70 years of age who were complained from neck pain and stiffness, between August 2018 and January 2020 in Al Muthanna college of medicine. The patients were divided into two groups, group (I) head weight carrier and group (II) non head weight carrier for comparison in degree of cervical spine degeneration. Cervical spine evaluated on lateral radiograph by measuring disc space and vertebral height from C2-C3 level to C7-T1 level and Gore et al scoring system to evaluate the degeneration of these levels.*

Result: *The disc space heights of C2-C3,C3-C4 and C7-T1 of group (I) were not significantly differ from that of group (II), the heights of C4-C5,C5-C6 and C6-C7 in group (I) were significantly smaller than that of group (II) with p- value 0.005, 0.009 and 0.030 respectively. The vertebral height of C3, C4 and C7 of group (I) not significantly different form group (II), the heights C5 and C6 of group (I) significantly smaller than that of group (II) with p-value 0.011and 0.048 respectively. The result of Gore et al scoring system of C2-C3,C3-C4 and C7-T1 of group (I) were not significantly different from that of group (II) while the scoring of C4-C5,C5-C6 and C6-C7 in group (I) were significantly different from that of group (II) with p- value 0.001, 0.008 and 0.009 respectively.*

Conclusion: *Extrinsic load on cervical spine from head weight lifting cause spine segment degeneration represented by disc space narrowing and decrease in vertebral heighet and osteophyte formation. the most affected level is C4-C5, C5-C6 and C6-C7.*

Keywords--- *Cervical Spondylosis, Cervical Spine, Osteophyte.*

I. INTRODUCTION

Cervical spondylosis is a nonspecific term that refers to any lesion of the cervical spine of a degenerative nature. in rural areas of Iraq, its common practice that the females carry heavy weights on their heads such fodder and clean domestic water along the way to their homes. These weights range from 5-40 kg daily for several years even they get older. They adapt method to balance these weights on their heads by stiffen and straighten their necks. The head loading places a greater stress on the intrinsic musculature and ligaments, which can only be relieved by assuming a vertical alignment of the lordotic curve in the cervical region [(1)].

Usama Jabbar Hawala, Department of Surgery, F.I.CM.S, F.A.C.M.S, College of Medicine, Al-Muthanna University.*
E-mail: asama84@yahoo.com; asama84@mu.edu.iq
Bashar Adnan Munshid, Department of Surgery, College of Medicine, Al-Muthanna University.
Ali Shahad Safi, M.B.CH.B D.O, Al Muthanna Health Directorate Al-hussein Teaching Hospital.

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Cervical spondylosis results from an imbalance between formation and degradation of proteoglycans and collagen inthe disc. Degenerative change is considered a response to insults, such as mechanical or metabolic injury, rather than a disease[(2)].All elements of the spine, including the intervertebral discs, joints, ligaments and bony structures, may undergo morphological changes that can be classified as degenerative[(3)].

Over the course of daily activities, the disc maintains a balance between externally applied loads and internal osmotic pressure. Fluid flow plays a key role in this process, causing fluctuations in disc hydration and height. Disc hydration impacts disc mechanics, mostly the stiffness and the creep properties in axial loading. Recovery of the disc height is dependent on the magnitude and duration of the applied load and unloaded recovery and on the surrounding environment [(1)].

II. PATIENTS AND METHODS

Cross-sectional study of sixty patients (all of them were a females) between 18 to 70 years of age who were complained from neck pain and stiffness, between August 2018 and December 2019 in Al Muthanna college of medicine. The patients were divided into two groups, group (I) head weight carrier and group (II) non head weight carrier for comparison in degree of cervical spine degeneration.

In this study, all patients were females, as the most of workers in urban area were females and to eliminate the effect of gender difference. They had no history of neck injury or fractures, and no history of inflammatory arthritis. The group (I) patients carry weights on their heads while group (II) patients had no history of head weight lifting ever.

Evaluation of degenerative changes of the cervical spine

In this study, two methods of evaluation were used

1. Lateral cervical spine used for automated measurement of disc space and vertebral height usingCR15-x AGFA where measurement recorded on x ray **(fig 1)**.
2. Using Gore et al. [(3)] scoring system which include three parameters: disc space narrowing, endplate sclerosis, and anterior/posterior osteophytes (table1) evaluated on lateral cervical spine by two radiologists independently.

All disc spaces from C2-C3 to C7-T1 and vertebral bodies from C3 to C7 were evaluated by both methods.

III. STATISTICAL ANALYSIS

Descriptive study in which the correlation between extrinsic axial load overhead and early spondylotic changes in cervical spine is determined. Statistical analysis was performed with the statistical package for social science (SPSS version 16).

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Figure 1: Show measurement recorded on x-ray for disc space and vertebral height

Table 1: Criteria for grading degenerative changes in cervical spine

Numerical value	Disc space narrowing	Vertebral end plate sclerosis	Osteophyte formation
0	None	None	None
1	25% decrease	Barely visible	Barely visible
2	50% decrease	Moderate	Moderate
3	75% decrease	Severe	Large

IV. RESULTS

The mean of age group (I) was (40.8) year and mean age of group (I) was (39.1) year (table II).

The disc space heights of C2-C3,C3-C4 and C7-T1 of group (I) were not significantly smaller than that ofgroup (II) with p value 0.887,0.122 and 0.090 respectively while the heights of C4-C5,C5-C6 and C6-C7 in group (I) were significantly smaller than that of group (II) with p- value 0.005, 0.009 and 0.030 respectively(table II).

The vertebral height of C3, C4 and C7 of group (I) not significantly different formgroup (II) with p value 0.620, 0.316 and 0.962 respectively while the heightsC5 and C6 of group (I) significantly smaller than that of group (II)with p-value 0.011and 0.048respectively (table III).

The result of Gore et al scoring system of C2-C3,C3-C4 and C7-T1 of group (I) were not significantly different from that ofgroup (II) with p value 0.684, 0.136 and 0.214 respectively while the scoring of C4-C5,C5-C6 and C6-

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C7 in group (I) were significantly different from that of group (II) with p- value 0.001,0.008 and 0.009 respectively (table IV).

Table I: Show ages of both groups

Age	Minimum	Maximum	Mean	Sd
Case	17.00	70	40.8333	13.66365
Control	18.00	70	39.1000	13.55538

Table II: Show the disc space heights for both groups

Level	group (I) mean ±SD	group (II) mean ±SD	P value
C2-C3	0.7847±0.15344	0.7797±0.11436	0.887
C3-C4	0.7607±0.16427	0.8133±0.07993	0.122
C4-C5	0.6983±0.14453	0.7877±0.08881	0.005
C5-C6	0.6777±0.12762	0.7540±0.08815	0.009
C6-C7	0.6880±0.13228	0.7533±0.09144	0.030
C7-T1	0.7330±0.13368	0.7827±0.08333	0.090

Table III: Show vertebral height of both groups

Level	Group (I) mean ± SD	Group (II) mean ± SD	P value
C3	1.4727±0.17648	1.5000±0.24300	0.620
C4	1.4690±0.18415	1.5220±0.22018	0.316
C5	1.3797±0.13366	1.5017±0.21641	0.011
C6	1.4030±0.15713	1.5050±0.22732	0.048
C7	1.5407±0.21640	1.5380±0.21680	0.962

Table IV: Show scoring system for both groups

level	Case mean	Control mean	P value
C2-c3	0.7667±1.0400	0.6667 ±0.84418	0.684
C3-c4	2.2333±1.6750 0	1.7000 ±0.95231	0.136
C4-c5	4.9000±2.02314	3.1000±1.78789	0.001
C5-c6	5.7000±1.85974	4.2333±2.23889	0.008
C6-c7	5.6667±1.82574	4.2333±2.23889	0.009
C7-c8	1.8333±1.36668	1.4000±1.30252	0.214

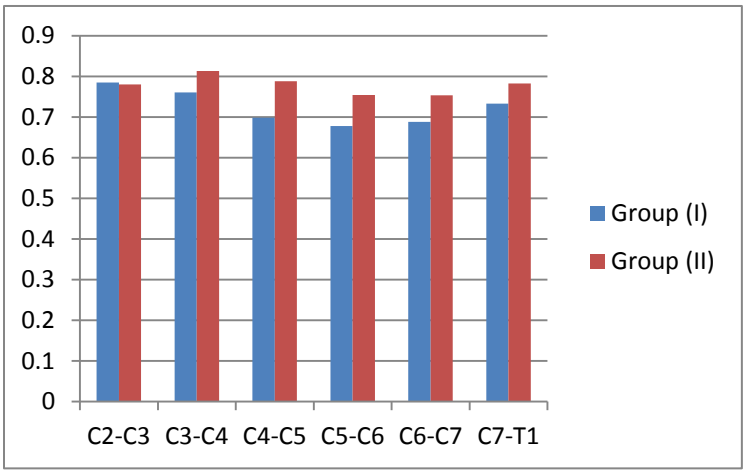

Figure 2: Show disc space height

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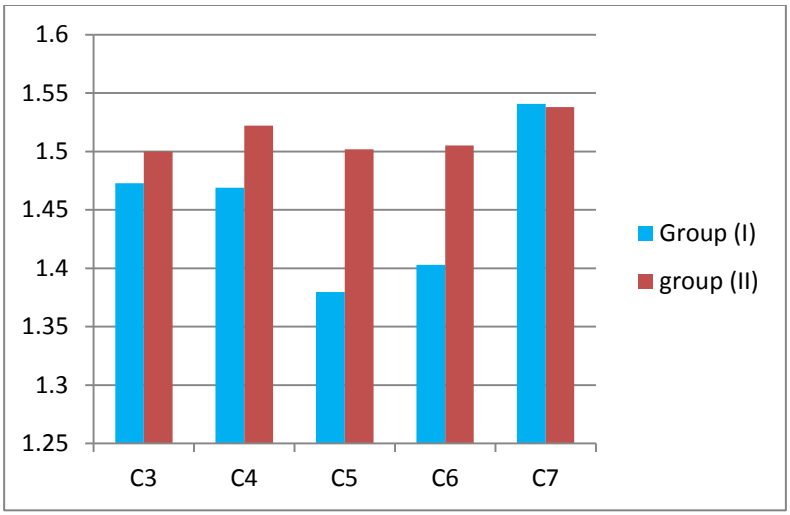

Figure 3: Show vertebral height

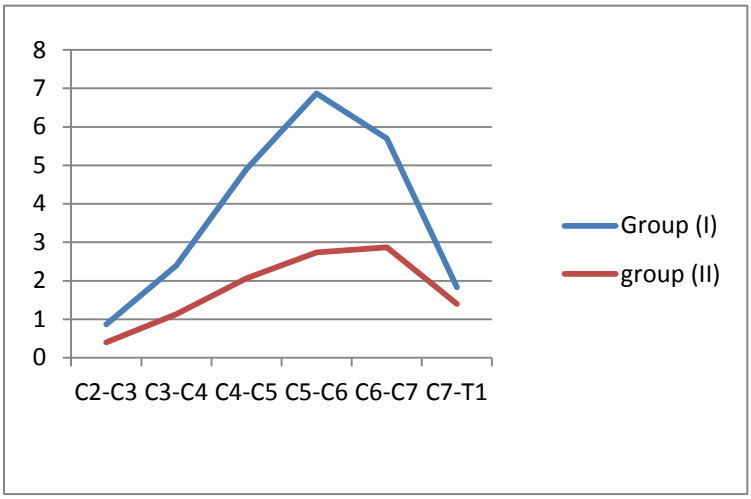

Figure 4: Show scoring system

V. DISCUSSION

During normal circumstances, Axial load that applied on cervical spine is three times the weight of head due action of cervical muscle that try balance head over the neck. This load increase during flexion and extension movements of neck [(4)]. The disc transfer and distribute compressive load on adjacent vertebrae with maintaining flexibility to bend and twist [(5)].Diurnal variation of daytime loading and night time unloading lead to disc height changes [(5,6)].The height changes of intervertebral disc result from outward fluid flow during axial compression and inward fluid flow during unloading [(7)].According to studies, the axial compressive force applied on neck from C2 to C7 conducted by three columns one anterior and two posteriors. The anterior column consists of vertebral bodies and intervertebral discs while the two posteriors, consist of the articulations of the articular processes on either side. the presence of lordosis where the spine curve posteriorly made the most of compressive force pass through posterior columns rather than anterior [(15)].

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According to the viscoelastic behavior of the annulus, when applying force then withdraw that force the strain in the elastic part promptly recovered, whereas the strain in the viscous component took time to recover so residual stain accumulate over time lead reduction in response to next cycle of force- strain over time[8]. loading the spine for long time leading for annulus bulges and more facet joints load with disc degeneration that alters the structure and function [9]. the axial strain of load-carrying on the head exacerbates degenerative change in the cervical spine [10]. the bony vertebrae respond to change in strain energy density and stress that may induce a remodelling process causing the formation of osteophytes especially adjacent to the degenerated disc and the anterior region of the cortex [4].

In this study found, overall decreases in disc space of cervical spine in group (I) compared to group (II) with levels C4-C5, C5-C6 and C6-C7 more affected with higher degeneration score than rest of levels. The least affected levels are C2-C3 followed by C3-C4 then C7-T1. The early changes that seen in head weight carrier was loss of lordosis, loss of lordosis and straitening of spine mean more force will pass through anterior column so more load on intervertebral disc.Disc degeneration in that levels (mobile mid cervical vertebrae)decrease movement in that levels and decrease in movement in adjacent level during flexion and extension[11].Despite the spondylosis is a multi-level disease but the C5/6 level being the most commonly affected[12].The Resnick et al.[13] conclude that the levels most significantly affected in cervical spondylosis are C5/6 and C6/7 while Echarri j. et al. concluded that more cranial vertebrae affected especially C3-C4 level in overhead wood bearer[17]. Jäger HJ et al conclude that the highest prevalence at the C5/C6 cervical segment followed by C4/C5 and C6/C7[10].

In this study, found significant decrease in vertebral heights of C5, C6 and C4 respectively with sparing of C3and C7.the possible explanations are large force generated from head weight lifting resisted by small size vertebras and other explanations is the influence of chronic recurrent stress with minor injuries to the vertebral bodies. Echarri j. et al. also found significant decrease in vertebral height due head weight lifting [17]. The decrease in both disc space and vertebral body height lead to shortening of anterior column that bring more load across the degenerated spinal segment to end up with kyphotic deformity of cervical spine.

Limitations to this study were it's a cross-sectional study not longitudinal, spinal canal and intervertebral canal not measured. Furthers studies need to understand the effect of axial load on cervical spine.

VI. CONCLUSION

Extrinsic load on cervical spine from head weight lifting cause spine segment degeneration represented by disc space narrowing and decrease in vertebral height and osteophyte formation. the most affected levelsare C4-C5, C5-C6 and C6-C7.

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