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Original Research Article

Analysis of Size Range of Twelfth Rib in Indian Population

Dr. Nitin Bansal[1*], Dr. Ruchika Garg[2]
[1]Assosciate Professor, Adesh Institute of Medical Sciences and Research, Bathinda, Punjab, India 151003
[2]Professor, Adesh Institute of Medical Sciences and Research, Bathinda, Punjab, India 151003

***Corresponding author**
Dr. Nitin Bansal
Email: nitinbansal2380@hotmail.com

Abstract: Low back pain (LBP) is characterized by pain or discomfort in the lumbar region, below the costal margin and above the gluteal fold that may or may not irradiate to the thigh. In case of absent or small twelfth rib, these functions of Quadratus Lumborum (QL) muscle may be disturbed and can be cause of low backache persistence or recurrences. But there is no sufficient supporting literature on the size of twelfth rib and variation in size in Indian Population. This study focusses on calculation of normal range of twelfth rib size in Indian Population which can further be utilized to analyse the role of QL size differences and low backache issues in patients with small or absent twelfth rib. Two hundred OPD patients were randomly selected for measurement of 12^{th} rib size on both sides. Twelfth ribs on both sides are measured either on chest x ray or Dorsolumbar spine xrays. Results for right rib are 6.6 – 15 cm and left twelfth ribs are 6.4 – 14.5 cm. From all the statistical analysis, it is concluded that any twelfth rib short in length than 6.5 cm can be coined as *small twelfth rib*.
Keywords: Low Back Pain, Quadratus Lumborum, Small Twelfth rib, Range

INTRODUCTION

Low back pain (LBP) takes a lot of toll on activities of daily living. Low back pain (LBP) or lumbago is characterized by pain or discomfort in the lumbar region, below the costal margin and above the gluteal fold that may or may not irradiate to the thigh [1]. LBP is a sensory and emotional experience that may be associated with trauma. The LBP, obtained through the clinical history of the patient classifies LBP into three categories: a) LBP associated with a specific cause in the spine, b) LBP associated with spinal stenosis, or c) LBP with a nonspecific cause. The first two diagnoses have defined etiology, since the pain has a specific cause and this pain affects less than 15% of the adult, adolescent and childhood populations. On the other hand, for the nonspecific LBP, the causal agent is unknown.

Although acute (and under some classifications, subacute) episodes that last up to three months are the commonest presentation of low back pain − and recurrent bouts of such episodes are the norm − chronic back pain ultimately is more disabling because of the physical impediment it causes and its psychological effects. Chronic back pain also has been caught up in medical controversies, especially about fibromyalgia and kindred syndromes or disorders and about what work-up and treatments are appropriate. Many doctors order elaborate studies when non-specific back pain is presented, including X-rays and magnetic resonance imaging, with little guidance to treatment decisions being the result. For arbitrary classification purposes, chronic pain generally is defined as pain that has persisted beyond normal tissue healing time (or about three months) [2], it is not merely acute pain that has lasted longer than would be expected for an acute episode [3].

LBP is a complex symptom with many diverse causes for its presentation. There are so many pain generators in such a small anatomical area responsible for pain. This makes the precise diagnosis of LBP very challenging. In most of cases, the underlying mechanical cause of low back pain heals on its own within 4- 8 weeks. Thus the determination of tissue etiology of LBP is not mandatory [4] rather it is

necessary to differentiate mechanical causes from more serious and pathological issues that require immediate treatment. The mechanical causes of LBP excluding radiculopathy focusses on muscle balancing out of which main focus lies on Quadratus Lumborum muscle – The joker of LBP [5, 6].

QL originates via aponeurotic fibers into the iliolumbar ligament and the internal lip of the iliac crest for about 5 cm. It inserts from the lower border of the last rib for about half its length and by four small tendons from the apices of the transverse processes of the upper four lumbar vertebrae. The quadratus lumborum can perform four actions: Lateral flexion of vertebral column, with ipsilateral contraction, Extension of lumbar vertebral column, with bilateral contraction, Fixes the 12th rib during forced expiration and elevates the Ilium (bone), with ipsilateral contraction.

In case of absent or small twelfth rib, these functions of QL may be disturbed and can be cause of low backache persistence or recurrences. But there is no sufficient supporting literature on the size of twelfth rib and variation in size in Indian Population. This study focusses on calculation of normal range of twelfth rib size in Indian Population which can further be utilized to analyse the role of QL size differences and low backache issues in patients with small or absent twelfth rib.

REVIEW OF LITERATURE

According to Jemmet *et al*. [7], given the low critical load of the lumbar spine, coordinated muscular activity is required to prevent excessive loading of the osseoligamentous elements leading to injury. A system of muscles with the ability to control segmental motion through multiple planes of movement is therefore necessary for the maintenance of spinal stability. Individually, the psoas major, transversus abdominis, quadratus lumborum and multifidus muscles have patterns of attachment in the lumbar region conducive to the maintenance of intersegmental stiffness. They are hypothesized to have the fundamental group architecture required to develop this intersegmental stiffness across multiple planes of segmental motion. The present study was designed to illustrate these individual and group characteristics. To varying extents, our understanding of the fundamental anatomy and architecture of the deep lumbar muscles remains incomplete. Further anatomical, biomechanical, neurophysiological studies should address the functional relationships between the psoas, quadratus lumborum, multifidus and transversus abdominis muscles as a group and in relation to the multi-segmental muscles of the lumbar spine in the context of lumbar stability.

According to Phillips *et al*. [8], the principal types of fascicles for Quadratus lumborum muscle are iliocostal, iliolumbar, iliothoracic, and lumbocostal. These fascicles arose from the iliac crest passed to the twelfth rib, from the transverse processes of lumbar vertebrae, from the lateral surface of the twelfth thoracic vertebra, or from the lumbar transverse processes and passed to the twelfth rib respectively. On the twelfth rib, fascicles attached to an area on the lower anterior surface that extended to between 4.5 and 7 cm from the head of the rib. On the iliac crest the muscle occupied an area extending from 5 to 7 cm laterally from a point opposite the tip of the L4 transverse process. Occasionally, fascicles arose from the iliolumbar ligament instead of the iliac crest.

According to Simons *et al*. [9], trigger points (TPs) in muscles of the lower torso associated with the spine are an important cause of low back pain. The quadratus lumborum is the muscle most commonly involved, but TPs located there are often overlooked because of inadequate physical examination techniques. TPs in the lower rectus abdominis refer pain horizontally across the low back, and those in the iliopsoas refer pain in a vertical pattern, parallel to the lumbosacral spine. The pain pattern of TPs in the serratus posterior inferior is noted in the region of the muscle itself.

Quadratus Lumborum Muscle originates via aponeurotic fibers into the iliolumbar ligament and the internal lip of the iliac crest for about 5 cm. It inserts from the lower border of the last rib (in case of absent twelfth rib, QL inserts on 11th rib) for about half its length and by four small tendons from the apices of the transverse processes of the upper four lumbar vertebrae (Grays Anatomy 20th Ed).

MATERIAL AND METHOD

Two hundred OPD patients were randomly selected for measurement of 12th rib size on both sides.

Inclusion criteria for study

Male/Female Orthopaedics OPD patients

Exclusion Criteria for study

Recurrent significant Backache [3], Renal surgery in past, scoliosis, absent 12th rib, any vertebral

anomalies like hemivertebra [4] or block vertebra, multiple rib fractures in past.

Ribs are measured either on chest x ray or Dorsolumbar spine xrays. For confirming twelfth rib, Lumbosacral x rays are also taken after proper bowel preparations. The measurement technique and magnification for digital x rays are calibrated as under:

The magnification using a steel sphere [10] and measurements by curved line on scales in digital x rays were used. Digital x-rays FCR PRIMA CR-IR 391 CL FUJIFILM was used. All the twelfth ribs were measured carefully using magnification markers and scales especially POLYLINE on the digital x rays.

Twelfth rib is determined by using spinal anatomy and alignment as per spinal deformity group protocol [11]. Twelfth rib is floating rib attached to Twelfth thoracic vertebra and for rib determination, vertebral numbering is very important. When the patient spinal anatomy is normal, numbering the spinal segments is relatively easy. This may not be the case when evaluating a spine with atypical segments or when a spinal deformity is present. T1 is defined as the first vertebra with a pair of associated ribs; all vertebrae distal to T1 with associated ribs are thoracic. Usually there are 12 thoracic vertebrae. The most common variations are 11 or 13 thoracic vertebrae. Identifying the terminal thoracic vertebra is not always a simple matter since distinguishing between a very small rib or thin elongated transverse process may be difficult. L1 will always be vertebra immediately below the last thoracic vertebra that is last vertebra with an associated pair of ribs.

Lumbosacral junction is another area of error as the last Lumbar vertebra may be sacralized or last sacral vertebra may be lumbarized. Intercristal Line the line joining the highest point of iliac crests is commonly identified at L4 – L 5 level on radiographs and rarely may cross the body of L4 (12) . From L5, T12 can be counted in reverse by counting five Lumbar vertebrae and confirmed.

After confirming T 12, twelfth rib is measured on both sides in digital x ray by curved scale method. All the data is recorded in Excel worksheet for further study and comparision.

DISCUSSION AND RESULTS

This study focusses on calculation of normal size range for twelfth rib in Indian population. Lot of variations are observed in twelfth rib size and structure in all male and female patients.

All data were analysed using the statistical package SPSS version 10.0 (SPSS Inc., Chicago, IL). Quantitative variables were expressed as mean values ± 1 SD, and/or median values (range). Significance testing was 2-sided and set to less than 0.05[13]. Levene test for equality of variances and t test for equality of means is used.

This study included both males and females (M: F = 1.6), total subjects are 200 (Table 3, Graph 1). Age group of two hundred subjects is mostly between 21- 70 years (92.5%) with only 7.5% in extreme age groups (< 21 years or > 70 years) (Graph 3).

Statistical analysis calculated twelfth rib size as mean 10.8 cm right and 10.4 cm left rib size (Table 1, Graph 1) and from there only this study calculated range of twelfth rib as Mean ± 1 S.D. Results for right rib are 6.6 – 15 cm and left twelfth rib are 6.4 – 14.5 cm. From all the stats analysis, it is concluded that any twelfth rib short in length than 6.5 cm can be coined as *small twelfth rib*.

Table-1: Size comparison of twelfth rib

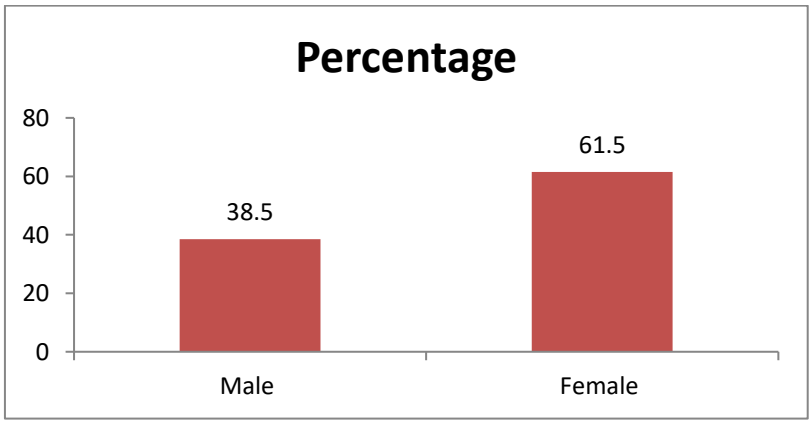
	VAR00003	N	Mean	Std. Deviation	Std. Error Mean
Rib	Right	199	10.8271	4.20791	.29829
	Left	200	10.3730	4.10156	.29002

Table-2: Statistical analysis of mean of both side

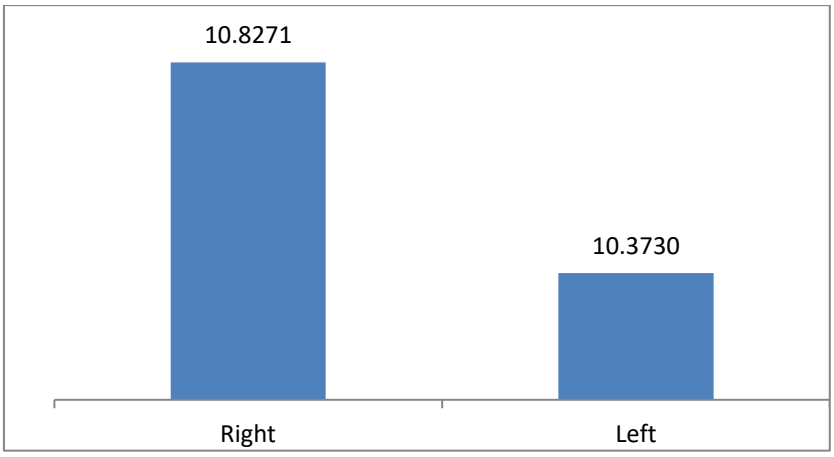
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Rib	Equal variances assumed	.207	.650	1.092	397	.276	.45414	.41602	-.36373	1.27201
	Equal variances not assumed			1.092	396.628	.276	.45414	.41604	-.36379	1.27206

Table-3: Sex distribution of data

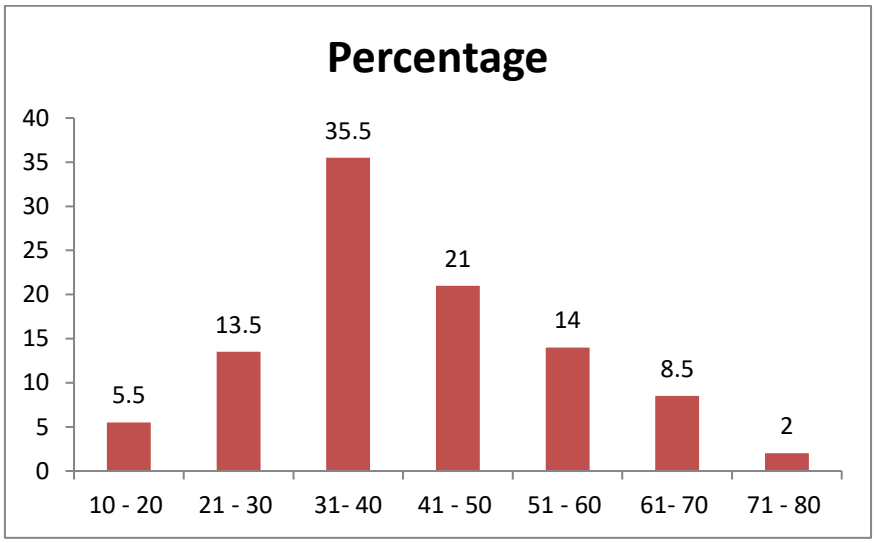
	No.	Percentage
Male	77	38.5
Female	123	61.5



Graph-1: Sex distribution of data



Graph-2: Size analysis of twelfth rib



Graph-3: Age distribution of data for twelfth rib

CONCLUSION

This study calculated the size of twelfth rib and coined the dimensions of SMALL TWELFTH RIB. Further comparative and detailed studies are needed to analyse the effects of different sizes or absent twelfth rib on new and recurrent low back pain issues. Detailed Cadaveric dissection is needed for analysis of insertion of Quadratus Lumborum muscles fascicles in case of unequal or absent twelfth rib.

Compliance with Ethical Standards

Conflict of Interest

The authors declare that they have no conflict of interest.

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Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Proper ethical and research committee approval has been taken.

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