Research Article

Study of medial end of fourth ribs with special reference to changes in pit shapes according to age, a qualitative approach

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ABSTRACT

Background: The objectives of this study were to find changes of pit shape at sternal end of fourth ribs in accordance with age in males, to find bilateral variability in changes of pit shape according to age and to compare the data with previous study.

Methods: Total 180 ribs were obtained from male cadavers brought for post-mortem examination. Out of which 140 ribs belonged to 70 cases were included in the study. Each rib was classified according to different stages of pit shape. The data derived were statistically analysed.

Results: Pit shape changes from shallow dent to 'V', from 'V' to 'U', from 'U' to 'wide mouth U' up to sixties of age and after that the quality of the walls surrounding the pit decreases without changes in shape of pit. There was no any bilateral variation found in pit shape changes for age.

Conclusions: Changes of pit shape at sternal end of fourth ribs are age dependent without bilateral variations. Age estimation by this method gives general idea about the age in decades only

Keywords: Pit shape, Sternal end of rib, Male

INTRODUCTION

Study of age dependent changes in human bones is by far the most important research tool till date. Age determination is comparatively easier task when whole body is available. Still it is easy when whole skeletons are found, but the task becomes challenging as soon as the availability of major bones decreases. Estimation of skeletal age falls into various groups which have marked differences in methods as well as accuracy. In general, greater the personal age the less the confidence quotient.¹ The problem arises from the major amount of variations in the aging process because of numerous internal as well as external factors.² After 25 years, reliability is only within a decade.³ This range can be narrowed by applying

multiple methods for age estimation at once e.g. Pubic bone changes⁴, skull suture closure⁵ criteria and morphological changes at sternal end of ribs. Iscan and loth studied metamorphosis at sternal rib end in white males and found pit shape and rim and wall configurations yielded better results than absolute pit depth alone.⁶ This study aims to focus at age wise changes in pit shape at sternal end of fourth ribs in males and to check for any bilateral variability.

METHODS

Fourth ribs from both sides were obtained from the bodies brought for the post-mortem examination after taking necessary consent from the relatives and concerned

investigating officer. Total 180 ribs were collected from 90 male bodies of age more than 17 years. The information about the age of the deceased was obtained from the nearest relatives and investigating officer and was verified by documents like driving license, Aadhar card etc. The cases with history of congenital or acquired chest deformities were excluded from the study.

Fourth ribs from both sides were removed by cutting them by rib shears few centimeters away from costochondral junction. After removing excessive muscular tissues, ribs were soaked in plain water in a container with identity tag for several days. All soft tissues and costal cartilage were then easily removed. In those cases where costal cartilage could not be removed easily, rib ends were boiled in plain water. Out of 180 rib ends 40 rib ends of 20 cases were discarded due to total damage of rib ends during process of removing cartilage. 140 rib ends were studied with special attention to shape of the pit as shown in figure 1 and classified according to the stages as described below.

Figure 1: Diagram of pit development at sternal end of rib (Side view).

The stages are:

1. Surface of the sternal end of rib is flat without any development of pit.
2. A slight dent is present.
3. Pit depth increases with formation of “V” shape of pit.
4. Floor of the pit expands with formation of “U” shape of pit.
5. Walls of sternal end of ribs starts thinning create illusion of opened mouth rib end, appear as wide mouth “U” shape pit.
6. Wide “U” shape pit with thin and brittle walls with some disintegration and projections of bone.

RESULTS

Each rib was classified according to the stage as described in material and methods. Mean ages were derived for different stages along with standard deviation and standard error. One way anova test were applied to find F-ratios as well as significance value. The data were compared with the previous study.

Table 1 shows that mean age increased as the stage increased at both sided ribs. Maximum number of samples were found with stage 4 (45.71%) on left side and (41.42%) on right side. No any sample was found with stage 1 and stage 6. Table 2 shows F -ratio was 46.300 and p-value was 0.000 for left sided rib ends and F -ratio was 51.942 and p-value was 0.000 for right sided rib ends.

Table 1: Side wise pit shape staging of fourth rib and its statistical analysis.

	Stage	N	Mean Age	Standard Deviation	Std. Error	Minimum Age	Maximum Age
L	1	00	-	-	-	-	-
	2	07	19.14	2.79	1.06	17	24
	3	27	33.00	8.47	1.63	19	52
	4	32	52.81	10.72	1.89	34	70
	5	04	65.00	5.09	2.55	58	70
	6	00	-	-	-	-	-
R	1	00	-	-	-	-	-
	2	07	19.14	2.79	1.06	17	24
	3	28	33.03	8.31	1.57	19	52
	4	29	52.96	10.53	1.95	35	70
	5	06	63.33	4.72	1.93	58	70
	6	00	-	-	-	-	-

(N=Number of samples, Std. Error=Standard error, NA=Not applicable, L=Left, R=Right)

Table 2: Side wise one way Anova analysis of fourth rib for pit shape.

		Sum of Squares	DF	Mean Square	F	Sig.
L	Between Groups	11683.768	3	3894.589	46.300	0.000
	Within Groups	5551.732	66	84.117		
	Total	17235.500	69			
R	Between Groups	12107.380	3	4035.793	51.942	0.000
	Within Groups	5128.120	66	77.699		
	Total	17235.500	69			

(Df=Degree of freedom, F=F-ratio, Sig.=significance, L=Left, R=Right)

In study done by Tyagi et al.⁷ on left sided ribs, mean age for stage 2 and stage 3 were 26.45 and 34.29, while in present study they are 19.14 and 33, indicates that mean age is approximately 7 years younger for stage 2 and 1 year younger for stage 3 in present study. Mean age for stage 4 was 43.33 in Tyagi et al.⁷ while in present study mean age for stage 4 is 52.81, indicates that mean age is approximately 9 years older in present study for stage 4.

In study done by Tyagi et al.⁷ on right sided ribs, mean age for stage 2 and stage 3 were 26.26 and 34.23, while in present study they are 19.14 and 33.03, indicates that mean age is approximately 7 years younger for stage 2 and 1 year younger for stage 3 in present study. Mean age for stage 4 was 43.33 in Tyagi et al.⁷ while in present study mean age for stage 4 is 52.96, indicates that mean age is approximately 9 years older in present study for stage 4.

In study done by Iscan et al.⁶, mean age for stage 2 was 22.8 while in present study it is 19.14, which suggests approximately 3 year younger age in present study. For stage 3, stage 4 and stage 5 ages were 30.5, 47.1 and 61.6 in iscan et al.⁶ study, while in present study they are 33, 52.81 and 65, which suggests approximately 3 year, 5 year and 4 year older ages in present study.

Paired T test was applied to find bilateral variations in pit shape changes according to age. The correlation coefficient was 0.999 for pit shape scoring according to age. Correlation coefficient of more than 0.8 is suggestive of strong correlation. So it is concluded that pit shape changes according to age have no any significant bilateral variation.

DISCUSSION

This method of age estimation is purely based on the observation only. There is a chance of inter-observer bias in deciding the stage to which the rib belongs. It will only suggest a primary idea about the age of deceased,

probably in decades. Moreover removal of cartilaginous part from rib end at the time of post-mortem examination of fresh body is very difficult task, but if the body is already in state of advanced decomposition it becomes easy.

The major advantage of this method is its applicability after second decade, when there are very few methods of age estimation available. So this may aid to those methods already available to narrow down the final range of age to give opinion. Future studies should be based on involving radiological technologies to make this method helpful in antemortem cases.

Changes of pit shape at sternal end of fourth ribs are age dependent. Early twenties show no pit to just shallow dent at sternal end of ribs. Pit shape changes from 'V' to 'U' to 'wide mouth U' up to sixties and after that the quality of the walls surrounding pit decreases without change in shape of pit. There is no any significant bilateral variation seen in pit shape according to age. Age can only be determined in large range, probably in decades, by this means.

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