ASSOCIATION BETWEEN REGERESSION IN TENSION TRABECULAE OF PROXIMAL FEMUR WITH AGEING

Anatomy

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ABSTRACT

Aim: To find out assocition between regression in tension trabeculae of proximal femur with ageing.**Method:** Volunteers of age $\geq$ 21yrs with defined inclusion and exclusion criteria enrolled for the study and radiographed as per mentioned protocols. **Results:** 276/300 were evaluated. we found significant linear trend of regression from fine mesh in 98.48% to completely reabsorbed in46.3% in extreme of age.In middle of age from Coarse51.02% to Markedly coarsened in 65.3%. **Conclusion:** We have found strong association of age with regression tension trabeculae of proximal femur and it is highly sensitive for age estimation .

KEYWORDS

Proximal femur, Tnsion trabeculae

INTRODUCTION .

Age estimation, combined with sex and ancestry assessment, is a key issue in identification of an individual in forensic science and archaeology.

Osseous tissue and teeth form the core of age estimation, due to both persistence and more used in archaeological work, when excavating prehistoric and historic skeleton. Assessing age is reliable in sub adults, as biological–chronological relationship is clearly reflected in growing bone skeleton, in epiphyseal, sphenobasilar ,synchondrosis and diaphyseal closure.

For adult skeleton, most methods focus on the nonsynovial joints of cranium, sacrum and inonminate bone.

Traditional methods of forensic requires time consuming preparation of the bone, and less sensitive for estimation of age in living (as soft tissue present) and archaeological studies[4]. Trabeculae are dense collagen tissue element in form of small beam/sturt(rod) ,having mechanical function.

According to tragectorial hypothesis of "Wollf law" every change in the form and function of the bone is followed by transformation in there internal and than external architecture.

Trabecular bone formation follows a regular pattern of distribution . Until one year of age arranged in straight bars that run parallel to the sagittal plane which begain to absorbed and replaced by"vault-like" pattern when child begins to walk and contracts the muscles of the hip more often.

Singh et. al.,(1970)were observed that trabeculae are resorbed in an ordered pattern. The order in which trabecular trajectories are resorbed corresponds to the intensity of stress acting upon that trajectory In general, fine trabeculae are resorbed first.

Mielke et al. (1972)found that horizontal trabeculae tend to be resorbed before vertical trabeculae.

The aim of the study is to assess association between regression in tension trabeculae of proximal femur with ageing for assessment of age in adult population in 10-year age wise groups of volunteers (age $\geq$ 21yrs) and to assess the gravity of association with other factors

MATERIALAND METHODS;

STUDY DESIGN: Observastional prospective study

STUDY CENTRE: Department of Anatomy, Department of Orthopaedics & Department of Radiodiagnosis, N.S.C.B. Medical College & Hospital, Jabalpur (M.P.) INDIA.

DURATION OF STUDY: 1st April 2016 to 31st March 2017

SAMPLE SIZE:
A total of 300 volunteers grouped as follows –
Groups   -   Years of age
Group 1-21   – 30
Group 2-31   – 40
Group 3-41   – 50
Group 4-51   – 60
Group 5-61   – 70
Group 6- $\geq$ 71s
In each group 50 volunteers with equal gender distribution.

Inclusion criteria-
*   Age$\geq$ 21 years.
*   Healthy volunteer with consent
*   Not suffering from any hip pathology.
*   No major systemic illness like hypertension, diabetes ,metabolic or autoimmune disease.
*   No history of prolonged use of drugs like corticosteroids, tranquilizers, calcium
*   No history of trauma.

Exclusion criteria-
*   Person with known age
*   Chronic illness like diabetes, hypertension, tuberculosis and metabolic diseases etc.
*   Any pathological bone diseases like vascular necrosis, osteomyelitis etc.
*   Congenital skeletal dysplasias .
*   Known muscular diseases
*   Prolonged drug history of steroids and other drug causing osteoporosis.
*   History of trauma
*   Antenatal,Immediate post partum(with in 6 month of delivery), lactating
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Investigation Details –
The radiograph taken in antero posterior plane of right and left hip joint in the healthy volunteer with standard protocol mentioned below
1.   MA – 200 ma
2.   KVP – 60 – 70
3.   MAS – (Exposure time) 24 – 32
4.   Tube to base distance - 100 cm
5.   For AP view supine position, internal rotation 15 degree, great toes

facing each other in midline.

The data of the present study is recorded / fed into the computers and after its proper validation, check for error; coding & decoding will be compiled and analyzed with the help of SPSS 20 software for windows. Appropriate univariate and bivariate analysis and the descriptive statistics will be carried out other statistical tests such as Student's t-test for continuous data and Fishers Exact Test or Ψ^2 test for categorical data will also be applied if the necessity felt to support the hypothesis.

All means are expressed as mean ± standard deviation and the proportion as in percentage (%). The critical value for the significance of the results will be considered at 0.05 level.

RESULT : We found significant gradual linear trend of regression from fine mesh in 98.48% at 21-30 years, to completely reabsorbed in 46.3% ≥ 71 years age. From Coarse 51.02% at 51-60 years to Markedly coarsened in 65.3% at 61-70 years of age. statistically this was highly significant .Bilateral and males/females difference is found but it is insignificant statistically. (Graph 2 Table -3)

Discussion:

Graph No-1 Age And Sex Wise Distribution Of Groups
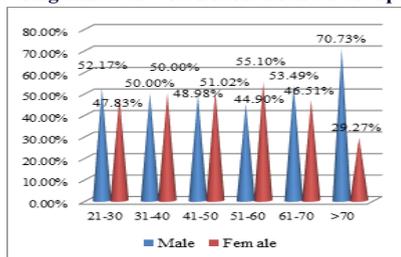
276 out of 300 radiograph are studied .Maximum number of male obtained in age more than 70 year . In rest of the group their number is 23-25. Number of female in each group is about 22-25.

We found difference between rate of regression in tension trabeculae in right and left femora which is statically not very much significant. (Table No. 1 & 2)

TABLE NO-1 Age20 * Tension Trabeculae R Crosstabulation

	Tension Trabeculae L					Total
	Fine – mashed and strong	Coarse and weak	Markedly coarsed	Markedly coarsed and show resorbtion	Completely Resorbed	
21-30	40	6	0	0	0	46
	75.5%	7.7%	0.0%	0.0%	0.0%	16.7%
31-40	8	39	1	0	0	48
	15.1%	50.0%	1.8%	0.0%	0.0%	17.4%
41-50	5	26	16	2	0	49
	9.4%	33.3%	29.1%	3.1%	0.0%	17.8%
51-60	0	7	33	8	1	49
	0.0%	9.0%	60.0%	12.5%	3.8%	17.8%
61-70	0	0	4	34	5	43
	0.0%	0.0%	7.3%	53.1%	19.2%	15.6%
>70	0	0	1	20	20	41
	0.0%	0.0%	1.8%	31.2%	76.9%	14.9%
Total	53	78	55	64	26	276
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

TABLE NO-2-Age20 * Tension Trabeculae L Crosstabulation

	Tension Trabeculae R					Total
	Fine – mashed and strong	Coarse and weak	Markedly coarsed	Markedly coarsed and show resorbtion	Completely Resorbed	
21-30	43	3	0	0	0	46
	71.7%	4.2%	0.0%	0.0%	0.0%	16.7%
31-40	10	37	1	0	0	48
	16.7%	51.4%	1.8%	0.0%	0.0%	17.4%
41-50	7	25	16	1	0	49
	11.7%	34.7%	28.1%	1.5%	0.0%	17.8%
51-60	0	7	32	9	1	49
	0.0%	9.7%	56.1%	13.4%	5.0%	17.8%
61-70	0	0	6	37	0	43
	0.0%	0.0%	10.5%	55.2%	0.0%	15.6%
>70	0	0	2	20	19	41
	0.0%	0.0%	3.5%	29.9%	95.0%	14.9%
Total	53	72	57	67	20	276
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Graph No-2 Age Specific Finding Of Tension Trabeculae (primary Trabeculae)

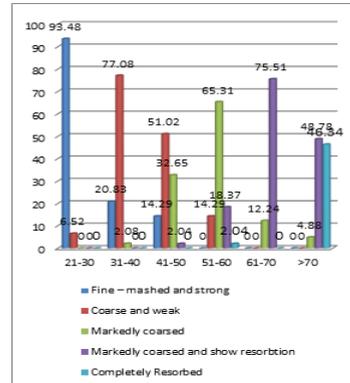**Table No. - 3age Specific Finding Of Tension Trabeculae (primary Trabeculae)**

Age20	Tension Trabeculae					Total
	Fine – mashed and strong	Coarse and weak	Markedly coarsed	Markedly coarsed and show resorbtion	Completely Resorbed	
21-30	43	3	0	0	0	46
	93.48	6.52	0.00	0.00	0.00	100.00
31-40	10	37	1	0	0	48
	20.83	77.08	2.08	0.00	0.00	100.00
41-50	7	25	16	1	0	49
	14.29	51.02	32.65	2.04	0.00	100.00
51-60	0	7	32	9	1	49
	0.00	14.29	65.31	18.37	2.04	100.00
61-70	0	0	6	37	0	43
	0.00	0.00	12.24	75.51	0.00	87.76
>70	0	0	2	20	19	41
	0.00	0.00	4.88	48.78	46.34	100.00
Total	60	72	57	67	20	276
	21.74	26.09	20.65	24.28	7.25	100.00

$x^2 = 517; P < 0.0001$

- **Tobin, 1955; Phillips et al., 1975** observed that most common site of fractures is area of Ward's triangle. This correlates with our findings that age > 61 Wards triangle is highly translucent.
- Kotting 1977 used, trabecular density, trabecular thickness and visual bone loss, he defined 8 phases of trabecular changes. On compareing with their each parameter we find that they are not sensitive for their phase classification .
- **Ericksen, 1979** observed that, age-related remodeling is not uniform within a single element, in the epiphyseal regions, remodeling tends to affect trabecular bone at a higher rate than cortical bone, so both are different, and our study correlate with them.
- **Singh et al., 1970; Tobin, 1955 were observed that b**etween the principal compressive group, the principal tensile group and the secondary, compressive, trabecular mesh, lies an area called as Ward's Triangle. As a person ages Ward's triangle gradually becomes translucent. This consides with our study.They observed that trabeculae are resorbed in an ordered pattern which corresponds to the intensity of stress acting upon that trajectory, fine trabeculae are resorbed first, which is confirmed by our study.[7,9]

- **Riggs and Melton, 1986** loss of trabecular bone may occur up to ten years before the loss of cortical bone begins. We did not find any such correlation.

X RAY NO -1-SHOWING FINE AND MESSHED TENSION TRABECULAE(28 YEAR)

X Ray No -2-Showing Coarse And Weak To Markedly Coarsed Tension Trabeculae(42 Year)

X Ray No -3-Showing Markedly Coarsed And Show Resorbtion Tension Trabeculae(69 Year)

Table -4-Comparision of present study with R A Walker and C.O.Lovejoy in Regression of tension trabeculae

PRESENT STUDY		R.A.WALKER AND C.O.LOVEJOY	
PHASE 1 –AGE-21-30	Fine – mashed and strong(93.48%)	PHASE 1 –AGE-18-24	fine-meshed
PHASE 2-AGE-31-40	Coarse and weak(77.08%)	PHASE 2-AGE-25-29	fine-meshed
PHASE3-AGE-41-50	Coarse and weak (51.02%) to markedly coarsed(32.65%)	PHASE3-AGE-30-34	still strong and fine-meshed
PHASE4-AGE-51-60	Markedly coursed(65.31%)	PHASE4-AGE-35-39	greater translucency
PHASE5-AGE-61-70	Markedly coarsed and show resorbtion (75.51%)	PHASE5-AGE-40-44	Less dense
PHASE6-AGE-71 AND ABOVE	Markedly coarsed and show resorbtion(48.78%) to Completely Resorbed (46.34%)	PHASE6-AGE-45-49	significant reduction
		PHASE7-AGE-50-59	coarse and greatly reduced in number.
		PHASE8-60 AND ABOVE	coarse and weak

Walker and Lovejoy's (1985) gave eight stages of radiographic finding in 5 years age wise groups of **Regression of tension trabeculae .**When we compare our study with their we found that their standards assigned more age categories that were off by more than 20 years from the true age at death than categories that were correct. Thus, this method appears to have little value to forensics. their method was found more accurate in the polar categories than in the middle age categories. But in current study we use 10 years age wise groups so in our result no such polar distribution of finding is found..As per radiographic finding we found linear treands and very sensitive for agewise change.They found females tended to have more erratic pattern of bone loss. **They** state that, in the femur, the degree and

pattern of bone loss are sexually dimorphic and become more variable in the third and fourth decade of life.which is well correlate with our finding (table 4 and Radiograph 1-2-3)

Macchiarelli and Bondiolini (1994) found that bone loss was influenced by the types of stresses put on the bone.This was more erratic in males than in females. They concluded that, due to variability in bone loss, the standards measuring the trabecular architecture of the proximal femur had only a weak chance of accurately placing individuals in defined age categories. said that radiographically, bone loss does not become visually apparent until at least 30% of the bone has been lost [16]. Our study does not correlate with them.

- **Parfitt et al. (2000)** They found that Sexually dimorphic microstructures may be related to variation in rates of bone deposition. We also find that there is significant difference between bone loss in male and female.
- **Wendy Michelle Jones (2003)** evaluated total of 240 individual of known age at death, sex and racial affinity. She compared her finding with those of **Walker and Lovejoy's in 1985** .She concluded that there are some strength and weakness in their techniques of age estimation. When we compare our study with her study we also conclude the same.
- **Huayue Chen, Xiangrong Zhou, Hiroshi Fujita, Minoru Onozuka, and Kin-Ya Kubo (2012)** concluded from their study that age-related bone loss and resultant osteoporosis in a substantial proportion of the elderly population is multifaceted and multifactorial, involving a progressive loss of both bone quantity and quality.

CONCLUSION- In current study author use single parameter which is associtin between regression in tension trabeculae of proximal femur with ageing for age estimation. We find it very sensitive for adult age group too and a linear pattern is observed between increase in age and regression rate of tension trabeculae. statically it very significant with other parameter we use it to estimate age in forensic and archeology more correctly in adult.

REFERENCES:
1. Cunha E, Baccino E, Martrille L, et al. The problem of aging human remains and living individuals: a review. Forensic Sci Int. 2009;193(1–3):1–13.
2. Mays S. The Archaeology of Human Bones. London: Routledge; 1998
3. Trabeculae of Bone: Definition & Function, *Study.com*. Retrieved 31 March 2017
4. Wolff, J., "Uber die innere Architektur der Knochen und ihre Bedeutung fur die Frage vom Knochenwachstum," Archiv fur pathologische Anato/nie und Physiologie und fur klinische Medizin, Virchovs Archiv, Vol. 50, 1870, pp. 389-453.
5. Townsley W, 1948 The Influence of Mechanical Factors on the Development and Structure of Bone. American Journal of Physical Anthropology 6: 25-39
6. Singh M, Nagrath A, and Maini P, 1970 Changes in Trabecular Pattern of the Upper End of the Femur as an Index of Osteoporosis. Journal of Bone and Joint Surgery 52A: 457-467
7. Mielke J, Armelagos G, and Van Gerven D, 1972 Trabecular Involution in Femoral Heads of a Prehistoric (X-Group) Population from Sudanese Nubia. American Journal of Physical Anthropology 36: 39-44
8. Tobin W, 1955 The Internal Architecture of the Femur and Its Clinical Significance. Journal of Bone and Joint Surgery 37A: 57-72.
9. Kotting D, 1977 Trabecular Involution of the Proximal Femur as a Means of Estimating Age at Death. MA Thesis, Kent State University, Kent, Ohio.
10. Ericksen M, 1979 Aging Changes in the Medullary Cavity of the Proximal Femur in American Blacks and Whites. American Journal of Physical Anthropology 51: 563-570.
11. Riggs B, and Melton L, 1986 Involutional Osteoporosis. New England Journal of Medicine 314: 1676- 1684
12. Walker R, and Lovejoy C, 1985 Radiographic Changes in the Clavicle and Proximal Femur and Their Use in the Determination of Skeletal Age at Death. American Journal of Physical Anthropology 68: 67-78.
13. Mielke J, Armelagos G, and Van Gerven D, 1972 Trabecular Involution in Femoral Heads of a Prehistoric (X-Group) Population from Sudanese Nubia. American Journal of Physical Anthropology 36: 39-44
14. Parfitt AM, Travers R, Rauch F, et al. (2000) Structural and cellular changes during bone growth in healthy children. Bone 27, 487–494.
15. Wendy Michelle Jones using Trabecular Architecture of the Proximal femur to Determine age at death: an Accuracy test of two methods December 2003
16. Huayue Chen,1 Xiangrong Zhou,2 Hiroshi Fujita,2 Minoru Onozuka,3 and Kin-Ya KuboAge-Related Changes in Trabecular and Cortical Bone Microstructure International Journal of Endocrinology Volume 2013, Article ID 213234, 9 pages http://dx.doi.org/10.1155/2013/213234