



Determination of Age from Epiphyseal Union of Bones at Shoulder Joint in Boys in Bagalkot region

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Abstract

Background: *The study of epiphyseal union of bones is considered a reasonably accurate and accepted as a standard method for age determination. There is a variation in the timing of appearance and fusion of epiphysis of the bones. So, the present work is to investigate the ages of epiphyseal union around shoulder joint radiologically in boys and to asses clinical relevance of non fused epiphyses in Bagalkot region.*

Material and Methods: *The present study has been conducted on 182 boys falling in the age group of 14 to 16 years, which are selected randomly from Basaveshwar English Medium School, Bagalkot, North Karnataka (India). They were subjected radiographic examination in Radiology department of Hanagal Shri Kumareshwar Medical College and Hospital, Bagalkot. The total number of beds in the hospital are 750 and also has PG training programmes in Forensic medicine department and also in other departments.*

Results: *In our study, among 14 years Boys, epiphyses viz, Head of Humerus, Acromion Process, and Coracoid Process were in 95%, 19% and 27% respectively of advanced union (i.e -stage IV) and 0%, 56%, and 17% were completely united (i.e- Stage V) in 14 years of boys.*

Among 15 year Boys, the epiphyses viz, Humeral head, Acromion and Coracoid process were in 1%, 5% and 3% respectively of advanced union (i.e-stage IV) and 5%, 56%, and 50% were completely united (i.e – Stage V) in 15 years of boys

Conclusion: *Relative difference among 14 year and 15 years Boys showing advanced union and complete union of epiphyses of humeral head, acromion process and coracoid process depicts that there is progressive ossification with age in boys of 14 to 16 years of age.*

Keywords: *Shoulder joint, Humeral Head, Acromion Process, Coracoid Process, Epiphyses.*

Introduction

Determination of age of an individual whether living, dead or from human remains is a vexing problem for medical jurist in both civil and criminal matters. Age estimation cases are often referred to forensic experts as it is very important issue to the court of law and to common man⁽¹⁾. In law the crime and punishment is entirely based on

criminal responsibility and this in turn depend on the age of a person. Age is helpful in identification of an individual which in turn helpful in both civil and criminal cases. The study of epiphyseal union of bones is considered a reasonably accurate and accepted method for age determination. India is a developing country and because of illiteracy and ignorance they do not

have proper documentation of births and death registration. Despite the fact that there are a number of laws requiring registration of births and (e.g, Registration of births and deaths Act 1969) most births are not properly recorded. It is an established fact that the sequence and ultimate ossification of epiphyses varies in both sexes in different part of world to the extent that there are wide variation even in the population of the different states of the same country.⁽²⁾ So the present work is to investigate the ages of epiphyseal union around shoulder joint radiologically in boys in Bagalkot region.

Material and Methods

The present study has been conducted on 182 boys, which are selected randomly from Basaveshwar English medium High School, Bagalkot, falling in the age group of 14 to 16 years in order to evaluate the epiphyseal union of Humeral Head, Acromion Process, and Coracoid Process in Shoulder joint by radiological examination. Inclusion criteria: healthy normal boys between age group who have completed 14 years and 15 years but not completed 16 years of age. Subjects who had documentary evidence of age in the form of birth certificate issued by municipal authority and of school records.

Subjects who were born and brought up in Bagalkot.

Exclusion criteria: Subjects with skeletal trauma/deformity, congenital or heritable anomalies, malformations or injury. Subjects with severe malnutrition, endocrinal disorders, chromosomal aberrations or chronic illnesses.

Staging of epiphyseal union: The status of ossification around shoulder joint based on classification given by Galstaun (1930)⁽³⁾, Mc. Kern Stewart (1957)⁽⁴⁾ and Kothari (1974)⁽⁵⁾ is as follows

Stage I: Beginning

Stage II: Active

Stage III: Recent union

Stage IV: Advanced

Stage V: Complete union

Data analysis: using software SPSS (20.0)

Results

Table No 01 Table showing that total number of boys selected randomly at the age of 14 and 15 years.

Sl.no	Age	No. of Boys
1	14 -15 Years	95
2	15 – 16 Years	87
	Total	182

Table no. 02 : Status of ossification in Shoulder joint in 14 years age group

	HUMERAL HEAD		ACROMION		CORACOID	
	N	%	N	%	N	%
Stage I	-	-	-	-	-	-
Stage II	-	-	-	-	-	-
Stage III	90	95%	18	19%	26	27%
Stage IV	5	5%	24	25%	53	56%
Stage V	0	0	53	56%	16	17%
Total	95	100%	95	100%	95	100%

Table no. 03 : Status of ossification in Shoulder joint in 15 years age group

	HUMERAL HEAD		ACROMION		CORACOID	
	N	%	N	%	N	%
Stage I	-	-	-	-	-	-
Stage II	-	-	-	-	-	-
Stage III	1	1%	4	5%	3	3%
Stage IV	82	94%	34	39%	41	47%
Stage V	4	5%	49	56%	43	50%
Total	87	100%	87	100%	87	100%

Out of 95 boys at age 14 years 5% of humeral head showed stage IV union where as none of the boys stage V union. Out of 87 boys at age 15 years 94% of humeral head showed stage IV union while 5% showed stage V union. In other words there is appreciable progressive union seen between age 14 and 15 year age from 5 to 94% in stage IV. This has a great clinical relevance that age of boys past 16 year old show progressive union and maturity of humeral epiphysis. However, limitation of our study is that we have not considered boys after age 16. There is no appreciable difference in acromion ossification stage of 14 and 15 year of age in male adolescents. The Coracoid Process epiphysis ossification union seen in 17% of 14 years boys and 50% of 15 years boys showed complete union (i.e., stage V). Our study suggests that ossification of Acromion starts showing early fusion as compared to Coracoid Process.

Discussion

Developmental and clinical anatomy of shoulder joint:

In the shoulder joint epiphysis of proximal humerus, acromion and coracoid process of scapula comprising our study for ossification maturity at age 14 and 15 year of boys.

Our study is more centered around Humeral head, Acromion and Coracoid Process of scapula as the cases in our study are 95- at age 14, 87 at age of 15 years. This is the reason we have not included other centers of ossification with limitation of study as it was done for 14 and 15 years of boys

Humerus: shortly after birth, ossification begins in the head of the bone followed by the appearance of the centers in greater and lesser tubercles at 3 to 5 years of age respectively. By age 6 year, all these centers are merged into a large epiphysis. The conical end of the proximal humerus fits as epiphysis into the glenoid cavity. The fusion of epiphysis takes place at age 20 to 22 year in male. Fracture of the proximal epiphysis of humerus – clinical relevance. Proximal humerus epiphyseal (nonfused) comprises 0.5% of

all the fractures, in children. There are three ossification centers of the proximal humerus epiphysis. Proximal humeral epiphysis begins to ossify shortly after the fully to ossify shortly after the full term birth with gestational age between 38 to 40 weeks and definitely seen by 3 to 6 months of age in infancy. The greater tuberosity apophysis begins to ossify at three year of age. The lesser tuberosity apophysis ossifies at 5 year of gestational age. Both the greater and lesser tuberosity ossifications fuse with each other at 6 year of age. Proximal humeral physis remains open until 16 to 18 year of age in boys. Damage to the physis can result in growth disturbances and leads to 80% of the longitudinal growth of the humerus⁽⁸⁾.

Proximal epiphyses of humerus develops into a sphere and articulates with glenoid cavity of scapula. Proximal humeral epiphyses begins to ossify shortly after birth. The proximal humeral physes remains open until 16-18 years in boys⁽¹⁶⁾. Damage to the physes can result in growth disturbances and lead to 80% growth disturbance in the proximal humerus. Non displaced or minimally displaced fracture of humerus treated non operatively. The severely angulated or displaced fracture may require open reduction and internal fixation in children age >10-13 years^(8,9). However before 11 of age in male the fracture of epiphyses usually gets well-modulated in shape and outline and no residual abnormality is seen. Surgical reduction is indicated when there is compromise of neurovascular bundle in the open proximal humeral fracture. Anatomical neck – Articular surface of the head of humerus seen medially upward and backward in position. surgical neck- is the narrower area just distal to the tubercle where fractures frequently occur.

Little league's shoulder is seen with overuse of the proximal humeral physis and is most likely a chronic non-displaced Salter-Harris Type – I. The injury occurs during growth spurts in boys between 11 to 14 years of age from an Acute non-displaced Salter-Harris Type – I fracture . In other words the little League's shoulder should be

avoided when there is a definite displaced Salter Harris Type-I proximal humeral fracture⁽¹²⁾. In presence of physal widening and or Juxta physal cysts (but no oedema) MRI may suggest only as chronic injury in fluid filled sequences⁽¹³⁾.

Osteochondritis Desicans (OCD) is of glenohumeral joint is of a rare identity. Acute and or repetitive microtrauma both are quite common in athletes and may cause OCD presenting symptoms including stiffness, locking and clicking. Acute or chronic microtrauma both are quite common in athletes and may lead to Avascular Necrosis (AVN) of humeral epiphysis. Stiffness locking usually clicks of stable Osteo Chondritis Desicans are treated non-operatively^(12,13). When loose bodies are apparent features of instability, debridement, drilling or allograft may be indicated^(12,13).

Greater tubercle of Humerus is the most lateral projecting of the shoulder joint. Its flattened surface is for the attachment of supraspinatus, infraspinatus and teres minor muscle. Lesser tubercle is more anteriorly placed and is separated by the intertubercular groove from the greater tubercle. It receives tendon of Lattissimus dorsi in the floor. The greater tubercle receives pectoralis muscle and lesser tubercle receives teres major.

Scapula: Ossification of body of scapula begins during 8th week of gestational age. At birth large part of body of scapula is bony except the glenoid cavity. Ossification of Acromion bone appear shortly after puberty and fuse with the rest of the scapular bone at age 16-17 and by age 20-21 year for the inferior angle and medial border. Our study also shows that ossification center of Acromion fuses earlier as compared to Coracoid process.

Acromion: Acromion has multiple development centers of puberty and fuses at 22 year of age. Persistence of multiple ossification centers of acromion mimics to a fracture and failure to fuse may lead to bipartite or tripartite acromion⁽¹⁰⁾. Proximal Humeral fracture comprise 0.5% of all the fracture in children. The force of injury resembles that of shoulder dislocation which decompress the proximal humerus. Unbalanced

biomechanical pull of the muscle insertions of both proximal and distal to the site of fracture leading to angular and displacement deformities. Spinous process of Scapula continues the Acromion which overhangs the shoulder joint. The lateral surface of the Acromion process provides origin of deltoid muscle. The smooth concave underside is related to the subacromial bursa. A forward directed part of Acromion has a medial and located a smooth facet which participates in the Acromio-Clavicular Joint. Adolescents have an imbalance between the strength and flexibility as they grow. Pediatric bones are more porous and susceptible to fracture as grow in length. The most of the extremity of shoulder joint fracture in children and adolescent who are engaged in athletic activities⁽¹⁵⁾. Normal fragmentary appearance of the Acromion ossification center and apophyses of the coracoid at coraco-clavicular ligament should not be considered as fracture⁽¹⁰⁾. A comparison study with the ossification of other opposite shoulder would help to further confirming multiple ossification centers not as a comminution.

Coracoid Process: The ossification centers of coracoid process appears by 1 years of age and fuses with the scapula at 14-15 years of age⁽¹⁶⁾. Coracoid Process is a thick upward projection from the neck of the scapula which turns forwards and lateral wards and provides attachment of pectoralis muscle, shorthad of biceps brachi muscle, coracobrachialis muscle, ligaments associated with shoulder joint esp. acromioclavicular ligament. Coracoid process and acromion is a site of insertion of pectoralis muscle. It is site of origin of coracobrachialis and biceps brachii (short head muscle)

Clinical relevance of the study associated with shoulder joint ossification centers

Shoulder dislocation: Dislocation of shoulder joint occurs between the ages of 10 and 20 years. Present Humeral physes appears to be protective displacement is typically anteriorly and posterior dislocation 2 to 4%.

Clinical significance is that the Acromion Process at its distal end may mimic as a fracture at the age of 14 and 15 years of male. By knowing the age of patient with clinical history one can confirm that it is an incomplete ossification of the Acromion and not a Avulsion fracture.

Study done by Dr. Saini .O.P et al of Jaipur region ⁽⁶⁾ as compared to our study shows 14.28% fusion of all epiphyses i.e., Head of Humerus, Acromion Process, Coracoid Process which is consistent with our study 0%, 56%, and 17% of complete fusion of all the three epiphyses at 14 years of age. Among the 15 years of age it is about 30%, 40% and 40% of epiphyseal union of Humeral head, Acromion, and Coracoid process, of study done by Dr. saini et. al, which is consistent with our study as 5%, 56% and 50% of complete fusion of all the three epiphyses.

Conclusion

Ossification of Acromion starts showing early fusion as compared to Coracoid Process. There is initial and progressive bony union of epiphyses around d shoulder joint at the age of 14 – 16 years of age. The dislocation of the proximal humeral epiphyses needs very careful management at age 11 to 13 year as modulation and alignment may be suboptimal and can compromise the vascular bundle.

Ethical clearance: Institutional ethical clearance was obtained.

Conflict of interest: Nill

Source of funding: Nill

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