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Original Research Article

A Comparative Study of Locations of Nutrient Foramina in Dry Human Scapulae: An Observational Cross-Sectional Study

Vandana Tiwari[1], Sonali Thomas[1], Prerna Chamoli[3], Jolly Aggarwal[4], Deepa Deopa[5]

[1]Associate Professor, Anatomy Department, GMC, Haldwani, Uttarakhand, India
[2]Assistant Professor, Anatomy Department, GMC, Haldwani, Uttarakhand, India
[3]Assistant Professor, Pediatric Department, GMC, Haldwani, Uttarakhand, India
[4]Professor, Anatomy Department, Govt. Doon Medical College, Dehradun, Uttarakhand, India
[5]Professor, Anatomy Department, GMC, Haldwani, Uttarakhand, India

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Corresponding author: Dr. Vandana Tiwari
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Abstract

Introduction: Human body normally has two bilateral scapulae also called as shoulder blades. They are flat triangular bones with cancellous tissue. They consist of body, neck and processes. They can be considered as modified long bones as they are involved in transmission of weight of upper limb to axial skeleton via clavicle. They are supplied by large sized nutrient vessels (branches from suparascapular and transverse cervical vessels) which enter through the nutrient foramina. This bone is not very well researched in our country, when it comes to nutrient foramina. But lately there has been increased interest in scapular blood supply, probably due to increased incidences of RTA or just awareness.

Purpose of study: To determine the number and location of nutrient foramina on the human dry scapula and to compare it statistically.

Materials and Methods: This descriptive cross-sectional study was conducted in the Department of Anatomy of G.M.C Haldwani, Uttarakhand, India. The study samples included 44 dry Scapulae bones of unknown age and sex. These scapulae have been collected over the years, from the voluntary donated bodies of Kumaon region and around. Statistical analysis was done on the results obtained.

Observations: The average number of nutrient foramina per scapula was five (ranging from 1-2). The most common location was of the supraspinous fossa, i.e,56%, and least common location was subscapular fossa i.e 0.06%. However, there was no significant difference in these locations was found based on laterality.

Conclusion: Hence surgeons performing scapular surgery like fractures fixation or bone grafting must emphasize on the topographic understanding of the nutrient foramina of scapula and its variations. This knowledge aids in minimising blood loss during surgeries around the pectoral girdle in living patients and also will preserve the vitality of grafted tissues.

Keywords: Scapula, Nutrient Foramen, Topography.

Introduction

Human body normally has two bilateral scapulae also called as shoulder blades. They are flat triangular bones with cancellous tissue. They consist of body, neck and processes. They can be considered as modified long bones as they are involved in transmission of weight of upper limb to axial skeleton via clavicle. They are supplied by large sized nutrient vessels (branches from suparascapular and transverse cervical vessels) which enter through the nutrient foramina. [1]

Scapular injuries are uncommon as they are all well covered by bulky upper limb musculature and displacement of fractured segments rarely seen (0.4-1% cases) [2]. Also, this is the anatomical basis, why easy healing possible following conservative management. Only few cases require surgical intervention/open reduction. Their fracture may occur in combination with other upper limb bones following high energy vehicular trauma, fall from height or may be during strong seizures attacks.

Hampering of blood supply due to damage to its nutrient vessels during injury or surgery may interfere with callus formation leading to mal-union or non-union; which may hypothetically affect the good patient prognosis. [3,4] This bone is not very well researched in our country, when it comes to nutrient foramina. But lately there has been

increased interest in scapular blood supply, probably due to increased incidences of RTA or just awareness.

So, in this study our aim is to determine and compare the number and locations of scapular nutrient foramina.

Material Method

This was an observational cross-sectional study, conducted in the osteology section of department of Anatomy, G.M.C Haldwani, after approval of institutional ethical committee. The study samples included 44 dry Scapulae bones (22 right and 22 left) of unknown age and sex.

These scapulae have been collected over the years, from the voluntary donated bodies of Kumaon region and around. All the scapula with normal morphology were included and damaged were excluded study. After visual inspection nutrient foraminas at three locations i.e supraspinous, infraspinous and subscapular fossae were included. Only the foramens admitting 24G hypodermic needle leading into nutrient canal (and oblique canal at one end), with a raised margin was considered to be Dominant Nutrient Foramen/DNF/NF.

For each scapula, location and number with laterality was noted on excel sheet and data were analysed statistically using JAMOVI software

Observations: On the samples examined, it was found that the most common site for nutrient foramina in scapulae is supraspinous fossa, both on right and left sides, however the values were not statistically significant.

The difference in the number at different locations was not found to be statistically significant.

Table 1: Distribution and numbers of nutrient foramina at various location of scapula

Right scapulae	No. of nutrient foramina	Count of scapulae	Total	Proportion	p
Supraspinous fossa	2	1	22	0.045	<.001
	1	16	22	0.727	0.052
	0	5	22	0.227	0.017
Infraspinous fossa	5	1	22	0.045	<.001
	2	1	22	0.045	<.001
	1	8	22	0.364	0.286
	0	12	22	0.545	0.832
Subscapular fossa	0	20	22	0.909	<.001
	1	2	22	0.091	<.001
Left scapula	**No. of nutrient foramina**	**Count**	**Total**	**Proportion**	**p**
Supraspinous fossa	0	7	22	0.318	0.134
	1	14	22	0.636	0.286
	2	1	22	0.045	<.001
Infraspinous fossa	1	7	22	0.318	0.134
	0	15	22	0.682	0.134
Subscapular fossa	0	20	22	0.909	<.001
	1	2	22	0.091	<.001

Table 2: Comparison in number at different locations among right and left sides of scapula.

Supraspinous fossa (figure 1)	Number of NF	Mean	SD	P
Right (22)	18	0.8182	0.501	0.576
Left (22)	16	0.7273	0.550	
Total (44)	34			
	56%			
Infraspinous fossa (figure 2)	**Number of NF**	**Mean**	**SD**	**P**
Right (22)	15	0.6818	1.129	0.201
Left (22)	7	0.3182	0.477	
Total (44)	22			
	36%			
Subscapular fossa (figure 3)	**Number of NF**	**Mean**	**SD**	**P**
Right (22)	2	0.0909	0.294	0.201
Left (22)	2	0.0909	0.294	
Total (44)	4			
	0.06%			

Figure 1: (showing two NF located in supraspinous fossa)

Figure 2: (showing NF located in infraspinous fossa)

Figure 3: (showing NF located in subscapular fossa)

Discussion

The scapula is a strong bone and protects the posterior upper chest. Developmentally it, arise from somatopleuric mesenchyme. Avian and mouse embryo studies have shown that the distal third of scapular blade is derived from the somites. [1] Its nutrient artery is the chief source of blood supply in prenatal and early life stages. Scapular foramina are rare findings, where a hole present through the scapular blade, in contrast to SNF/NF/DF, where only one entry hole is present.[9]

Scapular fractures are rare and indicate severe trauma. In the age of increasing road traffic accidents, the surgical fixation of scapular fractures is on rise, creating a need for increase in research regarding the vascularity of this bone. In our study we found the average number of nutrient foramina in scapula on right is between 1-2, and on left is approximately 0-1, which is in contrast to Donders et al [3] where it was found to be an average of 5 (0-10) per scapula and Sinha et al [6] where it was in rage of 2-10. It could probably because they also recorded the foramina in the periglenoid location, which was excluded in my study. In contrast to other researchers [7], we consider that periglenoid foramens could be because of epiphyseal vessels but not for nutrient vessels. Nutrient vessels by definition is known to be nourish the main body/ diaphysis of weight bearing long bones. In case of scapula the scapular blade is homologous to the diaphysis of long bones. (As depicted in image below) [5]

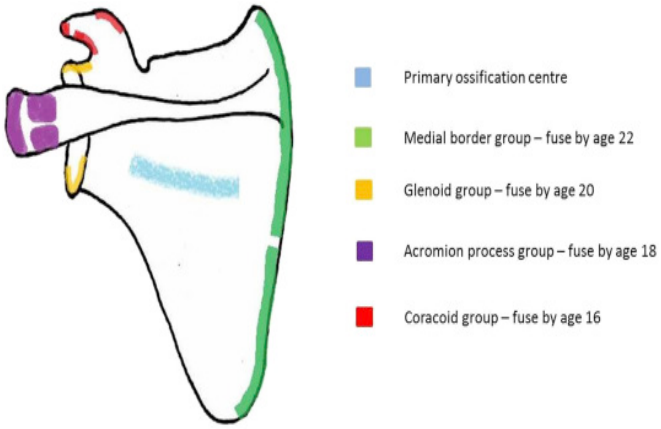

Figure 4: Ossification centres of scapula, courtesy: google

In our samples we found the most consistent location for nutrient foraminas to be supraspinous fossa, which is in line with other investigators. [3,6] However the difference in the occurrence among right and left sides at these locations was not found to be statistically significant. Out of 44 scapulae it was found that in one scapula of each side, none of the nutrient foramina were found in any of the three locations as in the study of Sinha S et al. [6]

Limitations of study: A small sample size and the lack information about the age, sex, and race the examined dry scapulae.

Conclusion

Detailed knowledge of vascularization in bones has been a decisive factor for the success of new techniques in orthopaedics, hence surgeons performing scapular surgery like fractures fixation or bone grafting must emphasize on the topographic understanding of the nutrient foramina of scapula and its variations. This knowledge will aid in minimising blood loss during surgeries around the pectoral girdle in living patients and al [8] so will preserve the vitality of grafted tissues in surgical procedures, reduce complications and will increase the success rate of surgical intervention. And lastly, as not has much been explored regarding the nutrient foramina of scapula, despites its limitation, our study is significant contribution to the literature available.

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