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STUDY OF HUMAN FETAL TALI CALCANEAL ARTICULAR FACETS

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ABSTRACT

Talus is the important tarsal bone which participates in the formation of talocrural, subtarsal and talocalcaneonavicular joints. In the subtalar region, anatomical variation is particularly present on the talus as well as on the calcaneus. The prior knowledge of anatomical setup of talus and its various articulations are significant in diagnosis of underlying pathology of the foot like Congenital telipes equinovarus, Pes planus, high arched foot etc. as a result there are changes in its morphology and also help in its treatment. Therefore, aims of the study are 1) to observe anatomical variations in human fetal tali by considering the presence and percentage of various patterns of calcaneal articular facets of tali, 2) To know whether the variation in patterns of calcaneal articular facets of tali, were predetermined or results due to walking habits, physique of a person and duration of weight bearing etc. in post natal life. This study was done in department of Anatomy, J. N. medical college, Aligarh (UP) India. Tali for this study were obtained from thirty human fetuses of late 2nd trimester and 3rd trimester without any apparent anomalies (Still birth or from infants who had died very soon after birth). Each fetal talus was carefully examined for the pattern of calcaneal articulating facets. The number of tali with a particular type of facets was noted and then they were classified into four groups. Type 1: Single facets were present in 46% of fetal tali. Type 2: Single articular facet, but divided into two parts by a prominent ridge in 27% of fetal tali. Type 3: Facet, partially divided by a non articulating groove and partly by a ridge in to two parts in 10% of fetal tali. Type 4: Continuity of the facet on the plantar aspect of head with the facet on the plantar surface of the body of talus was present in 17% of fetal tali. There is no literature available related to calcaneal articular facet in fetal tali for comparison of our results. Our study concludes that the presence of calcaneal articular facet in fetal tali probably are genetically determined which can be validated by imaging technique (MRI) in fetal life, being familiar with, may help in treating joint instability and correction of various foot deformity.

INTRODUCTION

The talus is the tarsal homologue of the carpal lunate. The fundamental difference between these two homologous structures is due to the weight-bearing function of the talus and typical bipedal stance and gait pattern of human beings. Talus (astragalus) is the second largest tarsal bone and it lies at the top of the tarsal skeleton. It is squat in a dorso-plantar direction, and elongated in a posteroanterior direction. Talus is unique, since it has no muscular or tendinous attachment (Faruqi, 2007). The inferior surface of the talus has three articulating surfaces separated by indistinct ridges, they are1) Large oval surface on its most posterior aspect, articulating with sustentaculum tali of calcaneum, 2) a flat surface on its anterolateral surface articulating with upper surface of calcaneum on its anteromedial surface, 3) medial facets, is the third facet articulating with spring ligament which is covered by articular cartilage. It takes part in the formation of talocrural superiorly and inferiorly there are two joints, posterior and anterior between the talus and the calcaneum. The posterior joint is named as subtalar or talocalcaneal joint. The anterior joint is a part of the talocalcaneonavicular joints (Faruqi, 2007; Williams and Warwick, 1992). The head of the talus fits into a socket formed partly by the navicular bone and partly by the calcaneum. Two ligaments also take part in forming the socket, are the spring ligament medially and the medial limb of the bifurcate ligament laterally. Classically the clinician considered that the subtalar joints are formed by three articular facets on the calcaneus supporting three corresponding facets on the plantar aspect of the talus. Talus is the key bone of the longitudinal arch, is the only bone through which the entire body weight load is channeled and

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transmitting to the plantar arch below (DeckerGAG and Plesis, 1986). The sinus tarsi separate these two joints. In the subtalar region, anatomical variation is particularly frequent on the talus as well as on the calcaneus. Besides anatomists the adequate knowledge of the talus anatomy is also significant to the orthopedic surgeons as the fracture of the talus is common and due to possible role of anatomical variation of the subtalar joints and ligaments on the outcome of ankle trauma (Kleiger, 1948). Talus is also involved in many diseases of the foot like CTEV, Pes planus, high arched foot etc. as a result there are changes in its morphology. In Pes planus or flatfoot there is loss of the medial longitudinal arch of the foot, it may be congenital or an inherited condition associated with mild subluxation of the subtalar joint (Yu-Chi Huang et al., 2004). Harris and Beath asserted that the fusion between the talus and the calcaneus was specifically responsible for the peroneal spastic flatfoot (Harris and Beath, 1948).

Donoghue and Sell quoted that talo-navicular synostosis in reality was a congenital absence of the navicular bone, accompanied by compensatory hypertrophy of the talus (Donoghue and Sell, 1943). In inversion and eversion, the entire part of the foot below the talus moves together. These movements take place mainly at the subtalar and talocalcaneonavicular joints and partly at the transverse tarsal joint. The calcanium and the navicular bone, move medially or laterally round the talus carrying the forefoot with them. Inversion and eversion greatly help the foot in adjusting to uneven and slippery ground (Chaurasia, 2010). Terry Trotter (1953) Williams and Warwick (1973), have described the different types of calcaneal articular facets, While Arora et al (1979), Bilodi & Agarwal (2003), Breathnach (1965), Jones (1949), have described the variations of calcaneal articular facets.

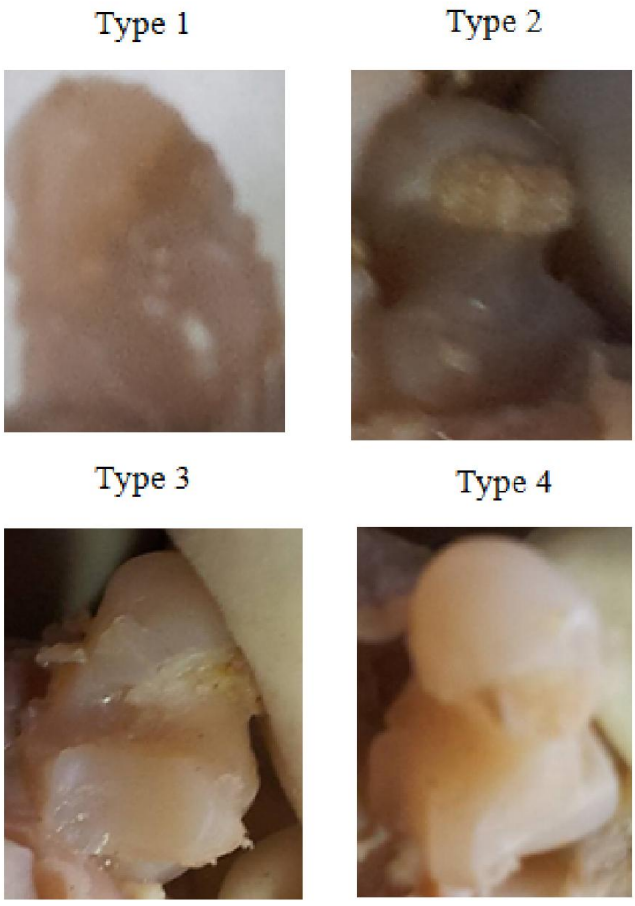
Aim of Study

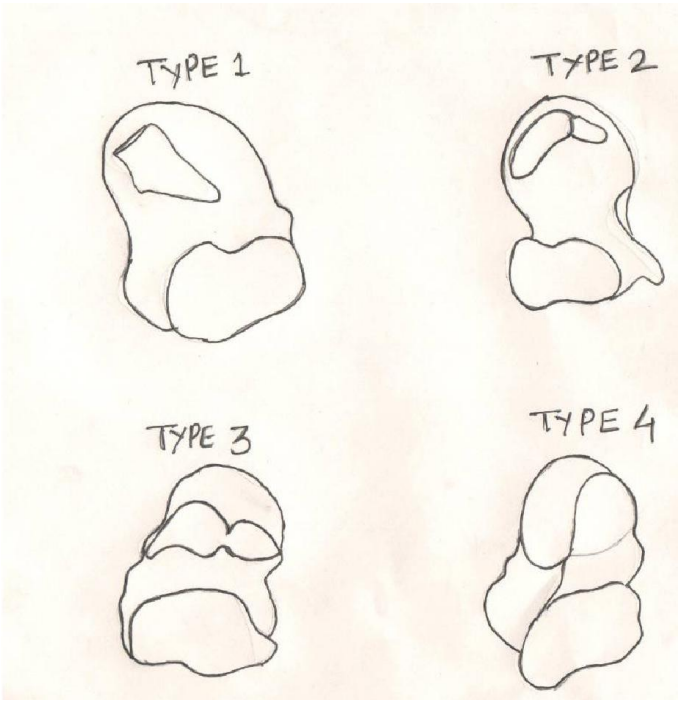
1. To know the presence, percentage of various pattern of calcaneal articular facets in human fetal tali.
2. To know whether they are prenatally determined or results due to physique of a person, weight bearing, type of gait or walking habits on plain/hilly areas.
3. How the study of calcaneal articular facets variation of subtalar joint is helpful in treating the various foot problems.

Study of variations in talar anatomy since birth can be helpful for reconstruction and rehabilitation of foot in ankle sprain/trauma and joint instability. Therefore, this study was designed to observe anatomical variations in fetal tali whether predetermined or results due to walking habits, physique and duration of weight bearing etc. in post natal life.

MATERIALS AND METHODS

The bones for this study were obtained from thirty human fetuses without any apparent anomalies (Still birth or from infants who had died very soon after birth) preserved in the museum of department of Anatomy, J. N. medical college, Aligarh (UP) India. Most of the fetuses correspond to late 2nd trimester and 3rd trimester. Postgraduate medical students have already been using these fetuses for their research work and sought permission from institutional ethics committee for this purpose. Tali were dissected out and removed. Each fetal talus was carefully examined for the pattern of calcaneal articulating facets. The number of tali with a particular type of facets was noted then the outline of the articulating surface marked carefully with the marker and then they were classified into four groups for their percentages calculation. Later they were photographed.





Line diagrams of the above fetal tali photographs.

RESULTS

The results of the present study in late 2nd trimester and 3rd trimester fetuses has shown four types of calcaneal articular facets and their percentage on the plantar surfaces of head of fetal tali (Table 1 and Table 2).

Type 1: Single facets were present on the plantar aspect of the head of the talus. They were present in 46% of fetal tali.

Type 2: Single articular facet on plantar surface of head of talus, but divided into two parts by a prominent ridge i.e. the middle calcaneal facet and anterior calcaneal facets. They were present in 27% of fetal tali.

Type 3: Calcaneal articular facet on the plantar surface of talus, partially divided by a non articulating groove and partly by a ridge in to two parts. They were present in 10% of fetal tali.

Type 4: Tali showed continuity of the facet on the plantar aspect of head with the facet on the plantar surface of the body of talus. They were present in 17% of fetal tali.

Table 1. Types of calcaneal articular facets of fetal tali and their percentage

S.No	Types of calcaneal articular facets of fetal tali	No. of tali	Percentage
1	Type 1	28	46 %
2	Type 2	16	27 %
3	Type 3	06	10 %
4	Type 4	10	17 %

analage of the foot. The differentiation of the tarsus follows that of the metatarsals.

Cartilaginous stage

Cartilage cells form in the mesenchymal –prochondral analage. The chondrification of the foot is initiated in horizon 18, and the last element, except for the sesamoids, chondrifies in horizon 23 which represents the end of embryonic period proper. As the process of chondrification advances, the skeletal elements become clearly identifiable and morphogenesis aiming toward the adult form. The chronologic sequence of chondrification occurs in 14 stages by senior (Senior, 1929). The central three metatarsal chondrify first, followed by fifth metatarsal and the cuboid. The chondrification of the tarsus continues with the calcaneus, the talus and 2nd—3rd cuneiforms then the 1st cuneiform and 1st metatarsal follows. The navicular is the last tarsal element to chondrify.

Osseous stage

The forefoot ossifies prior the hindfoot. In hindfoot, calcaneus is the first to ossify. The talus may begin to ossify during the eighth lunar month. Oliver G describes that the talus is delineated at horizon 18 (Oliver, 1962). At 27 mm (horizon 22) there is over lapping of talus and calcanium. Initially the talus is narrower and longer, only superior and lateral articular surface observed but separated apart. Only the lateral third of the lower surface establish contacts with the calcaneus. In horizon 23 (at 34 mm) talus more or less resembles the adult structure i.e. the sustentaculum tali is well developed.

Table 2. Percentage of calcaneal articular facets of fetal tali in Rt and Lt foots

S. No	Types of calcaneal articular facets of fetal tali	Total. No. of tali	Right side foots tali	Percentage	left side foots tali	Percentage
1	Type 1	28	16	57 %	12	43 %
2	Type 2	16	04	25 %	12	75 %
3	Type 3	06	02	33 %	04	67 %
4	Type 4	10	08	80%	02	20 %

Table 3. Comparison of (%) of types of tali in Indians adults' race by different worker

Race	workers	year	Percentage of types of tali				
			Type 1	Type 2	Type 3	Type 4	Type 5
Indians	Arora et al	1979	16 %	78 %	1 %	3 %	2 %
Indians	Bilodi & Agarwal	2003	10 %	14 %	20 %	---	56 %
Indians	Bilodi	2006	10 %	50 %	17 %	5 %	18 %
North Indians	Mandeep kaur et al	2007	45 %	24 %	9 %	5 %	17 %

DISCUSSION

The foetal embryonic period is studied into 23 horizons. At 4 weeks, in horizon 13 a very small lower limb bud germinates opposite the 5 lumber and first sacral myotome. Horizon 23 corresponds to the end of the embryonic period proper i.e. the eighth embryonic week and average C-R length of 30mm. In the formation of skeletal elements there are three stages: mesenchymal, cartilaginous, and osseous.

Mesenchymal stage

The foot plate is already present in horizon 17 and 18. The mesenchyme condenses than differentiates, and forms the

The dorsal, lateral and medial articular surfaces of the talus have merged. Variation in size and contour of the inferior articular surfaces of the talus has been described by Shahan K. Sarrafian1993. There is no literature available related to calcaneal articular facet in fetal tali for comparison of our results. However the results are compared for different types of tali with the study of different worker in Indians adult race (Table 3). The result of the present study in late 2nd trimester and 3rd trimester fetuses (incidence of various types of tali) is more or less similar to study of Mandeep Kaur et.al, Amritsar (2011) in north Indians adults. It indicates that they are prenatally genetically determined. At the same time Variation in the incidences of various types of tali of Arora et al (1979), Bilodi & Agarwal (2003) and Bilodi (2006) work could be due

to population differences or place of living in hilly areas. Thus these anatomical variants of calcaneal articular facet of tali (i.e. subtalar joint) exist from the earliest days of life. In subtalar region anatomic variation is frequently responsible for ankle sprain, followed by talar instability. Other causes of instability or hyper mobility of the subtalar joint are lesion of talocalcaneal ligaments. The prior acquaintance with the anatomical set up of talus and its various articulations has significance not only in knowing the underlying pathology but also helps in its treatments.

Conclusion

To conclude this study it can be stated that 1. The presence of calcaneal articular facet in fetal tali of late 2nd trimester and 3rd trimester indicates that probably they are genetically determined. 2. The presence of the calcaneal articular facets can be validated by imaging technique (MRI) in fetal life, being familiar with which may help in treating the frequently encountered joint instability and correction of various foot deformity, those are due to anatomic variation of facets and lesion of talocalcaneal ligaments in subtalar region.

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REFERENCES

Faruqi, NA. Tarsal bones in: Handbook of osteology, ed. First, C.B.S publishers and Distributors, New Delhi, 2007; p.104.

Williams and Warwick 1992-Gray's Anatomy-E.L.B.S-37th Edition-London- 450p.

DeckerGAG, Plesis D.J, 1986-Lee McGregor's Synopsis of Surgical Anatomy12th Edition,-Indian Edition-K.M. Verghese Company -539p.

Kleiger B. Fractures of the talus. J Bone Joint Surg 1948 Jul 3; 30(A): 735-743.

Yu-Chi Huang et al. The relationship between the flexible flatfoot and plantar fasciitis: Ultrasonographic evaluation. Chang Gung Med J 2004 June; 27(6): 443-447.

Harris RI, Beath T. Etiology of peroneal spastic flatfoot. J Bone Joint Surg 1948; 30(B): 624-633.

Donoghue O, Sell 1943. Cited by Webster FS, Roberts WM. Tarsal Anomalies and peroneal spastic flatfoot. J Am Med Assoc 1951; 146(12): 1099-1104.

B D Chaurasia 2010 -Human Anatomy-CBS Publishers 5th Edition New Delhi-- p.162-163.

Terry R.J. and Trotter M. 1953-Morrison Human Anatomy-A complete systemic treatise edited by J.B.Schaffer -11th Edition- Blackiston Company Network Toronto - 267p.

Williams and Warwick 1973-Gray's Anatomy 35th British ed. -Philadelphia : W. B. Saunders Co., 1973.

Arora A.K. Gupta.S.C, Gupta C.D. Jeysing.P 1979 Variations in Calcaneal articular Facets in Indian Tali- Anat Anz 146-377-380.

Agrawal BK, Bilodi AK. Study of fifty human tali for calcaneal articular facets. Medical J Kathmandu Univ 2003; 2(3): 213-215.

Breathnach AS. The skeleton of the foot. In: Frazer's Anatomy of the human skeleton. 2nd Edition. London: Churchill Ltd; 1965; 141-145.

Jones F.W 1949-Structures and Function as seen in Foot 2nd Edition Baillire Tindall and Cox London-72.

Senior HD: The chondrification of the human hand and foot skeleton. Anat Rec 42:35, 1929.

Oliver G: Formation du Squelette des Membres. Paris, Vigot Freres, 1962.

Anatomy of the foot and ankle—2nd edition by Shahan K. Sarrafian1993

Manpreet kaur et al-- Morphological classification of tali on the basis of calcaneal articular facets—Pb journal of orthopaedics Vol-xii, No. 1, 2011.

Bilodi AK. Study of calcaneal articular facets in human tali. Medical J Kathmandu Univ 2006; 4(1): 75-77.

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