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CONTENT

EDITORIAL

Anatomy Research: Is there scope?

The study of human anatomy and research in human anatomy dates back to more than 2,000 years, to the period of Ancient Greeks. It can be divided into several broad areas namely Human gross or macroscopic anatomy, microscopic anatomy, developmental anatomy or embryology, medical genetics, imaging anatomy and most recent addition molecular anatomy.

Human anatomy is the science of studying and understanding the structure and organization of the human body. Understanding the structure and organization of the human body is the key to the practice of health and medicine and thereby research in Anatomy is essential for the further advancement in medicine.

The word "anatomy" comes from the Greek words "ana," meaning "up," and "tome," meaning " cutting." Traditionally, studies of anatomy and research in anatomy have depended on cutting up, or dissection, but recently, with imaging technology, it is increasingly possible to see how a body is made up without dissection.

In the present time the value of research in gross anatomy has being challenged, mentioning that anatomy is an already well explored and documented area of research. However, variations play a key role in everyday surgery. Complications resulting from a new procedure can be due to the presence of an unexpected anatomical variant. The dissecting room need to be used to refine the new techniques taking this possibility into account rather than abandoning an otherwise valid surgical advance. In addition in an era where we talk about personalized medicine and where scientists are capable of developing functional ears, bones and muscle structures using 3D-bioprinting technology I totally disagree regarding the less importance in research of anatomical variations. Information from computed tomography (CT) and magnetic resonance imaging (MRI) scans can be used to create structures that are unique to each patient through the Integrated Tissue and Organ Printing (ITOP) system and this will benefit patients immensely. Anatomist's role as a member of the multidisciplinary research team is exponentially increasing each day. Emergence of 3D printing in recent years, is a promising strategy for the growth of complex tissues and organs which could replicate those of the human body.

Molecular anatomy is the subspecialty of microscopic anatomy concerned with the identification and description of molecular structures of cells, tissues, and organs. Staining with special stains,

cryosection imaging, immunohistochemistry and immunofluorescence can be used to research in neuroendocrine markers, neuroimmune connections, angiogenesis etc. Recent developments in immunohistochemistry and/or in situ hybridization, molecular cell markers and their applications and the development of advanced computer-aided three-dimensional reconstruction programs could be used to understand various aspects of embryological development. Human embryology also offers a wide field of research, which explains the variations that exist in the adult.

Few recent anatomical discoveries are mentioned to highlight the scope for anatomy research. The discovery of the presence of lymphatic system in the Central Nervous System (CNS) where the lymphatic vessels were seen in the meninges indicating relevant cross talking between CNS and peripheral immune system and perhaps affecting autoimmunity. Until this recent research findings, it was believed that lymphatics were absent in CNS and it was anatomically immune privileged due to the presence of the blood-brain barrier around it. Also unravelling the previously unknown parts of the human mesentery in adults and discovering human mesentery to be present all along the intra-abdominal gut tube established the fact that it is a continuous entity found all along the intra-abdominal gut tube disproving the concept that it is fragmented in the adult humans. Thirdly, a recently reported discovery is the demonstration of existence of a previously unknown and unseen tissue component, 'interstitium'- a networked collagen bound fluid-filled space in a number of human organs. These fluid-filled spaces were discovered in connective tissues all over the body, including below the skin's surface; lining the digestive tract, urinary systems, lungs; and surrounding muscles.

Despite Sri Lanka being recently elevated to an upper-middle-income country, there is general concern that the culture of research in Sri Lanka is still not as healthy as it should be and as Anatomists can we contribute to the new knowledge that Sri Lanka need to be producing that could be assessed by its research output, most commonly measured by publications and patents.

I will conclude by saying it is not impossible to discover a new body part/tissue in this day and age and certainly there is high scope for Anatomy research but the Anatomist should be assisted by the newer technology, have an eye for identifying research topics and need to function in a multidisciplinary team to generate better results.

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REVIEW ARTICLE

Revisiting the anatomical basis of varicocele

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Abstract

Objective: We intended to revisit aetiology and pathogenesis of varicocele.

Results: Several theories were proposed as for the aetiology of left sided varicoceles being commoner than right sided varicoceles such as compression of the left testicular vein by the sigmoid colon, high concentration of adrenaline in the left renal vein causing vasospasms of the left testicular vein, presence of a right angle between the left testicular vein and the renal vein, "nutcracker effect" secondary to a compression of the left renal vein between the superior mesenteric artery and the aorta distal to its confluence with left testicular vein, and the presence of incompetent venous valves of the internal spermatic vein draining the left renal vein causing back flow of the blood. However, these theories were challenged in subsequent studies. Recent studies explored the ultrastructural changes of the pampiniform venous plexus in patients with varicoceles. Histological studies identified changes in the connective tissue density, endothelium and smooth muscle arrangement in these veins. However, the causality of these changes is not yet studied extensively. Genetic studies looking at matrix metalloproteinases synthesis and degradation, inflammation, immune dysregulation or alterations of metabolic pathways are necessary to understand pathogenesis of this clinical entity.

Keywords: varicocele, anatomy, histology, pathology

Introduction

Varicocele is the abnormal dilatation and the tortuosity of the pampiniform plexus surrounding the testis and dilatation of the internal spermatic vein (1). This clinical entity was first described in the 16th century by the French surgeon Ambroise Pare as dilatation of veins due to sluggish blood flow (2). Majority of the varicoceles (80-90%) are found in the left scrotum; while 30-40% occur bilaterally (3). The prevalence of varicocele is 15% to 19% among males (4,5). Varicoceles contribute to 35% of primary and 80% of secondary subfertility (6). However, aetiology of varicocele is believed to be multifactorial and the exact pathophysiology for this condition is unknown (6).

Main Text

Theories for the left sided varicoceles being commoner than the right sided varicoceles

Several theories have been proposed as for the prevalence of left sided varicoceles being commoner than right sided varicoceles. One reason could be the direct compression of the left testicular vein by the sigmoid colon (7). Another theory was the high concentration of adrenaline in the left renal vein causing vasospasms of the left testicular vein as the left suprarenal vein, similar to the left testicular vein, directly drains to the left renal vein unlike on the right (8). Moreover, presence of a right angle between the left testicular vein and the renal vein may contribute to the pathogenesis of left sided varicoceles. The right angle may lead to an increased hydrostatic pressure leading to dilatation of the left testicular vein (8,9). An alternative theory suggested the change in the normal pressure gradient caused by a "nutcracker effect" secondary to a compression of the left renal vein between the superior mesenteric artery and the aorta distal to the confluence with the left testicular vein (8,10). Nevertheless, in a venography study done on 67 patients with left sided varicocele, 14 did not have a compressive cause (11). Shafik et. al, following measuring the internal venous pressure of renal vein in varicocele and a non-varicocele control group found that there was no significant pressure change in the two groups (10). Findings of this study were confirmed by subsequent studies (9,12).

Another theory on pathogenesis of varicocele was the incompetent venous valves of the internal spermatic vein draining the left renal vein causing back flow of the blood (6). Contrasting this theory, varicocele was observed in patients with or even without the presence of internal spermatic venous valves (12). Out of 659 patients who underwent a venography study with left side idiopathic varicocele, 484 did not have valves while, 172 had competent valves (12). Wishahi et. al, during internal spermatic vein dissection in 70 fresh human cadavers demonstrated the absence of valves, thereby questioned the reflux due to valvular incompetency as a cause for varicocele (13). Retro aortic left renal vein was found to be associated with a high incidence of left sided varicoceles in several studies (14,15). Nevertheless, the studies failed to determine the exact reason for this association.

Ultrastructural changes of the pampiniform venous plexus in patients with varicoceles

Shafik et. al, demonstrated a significant reduction in pressure in the internal spermatic vein of varicocele patients (9 to 18 Hg mm) compared to the non-varicocele (22 to 28 Hg mm) individuals despite the renal vein pressure being almost similar in both groups (10). This highlighted the possibility of microscopic changes in the internal spermatic vessel wall and the pampiniform plexus that could be causing the reduction in the pressure gradient between renal vein and testicular vein.

Over the next few decades, many researchers looking into the microscopic appearance of the testicular veins proposed new theories to explain the pathogenesis of varicoceles. Iafrate et. al, conducted a histological analysis of the pampiniform plexus of 30 patients with varicocele and found out that the connective tissue content increased in the outer layers of the vessels with the advancement of severity of varicocele (16). They also found a reduction in the number of vasa vasorum in the adventitia and a reduction in the oblique muscle fibres located between circular and longitudinal muscles (16). In contrast, Tanji et. al, reported in 16 patients with varicocele following an electron microscopic examination of the spermatic veins, that there were only two muscle layers (inner circular and outer longitudinal) and according to the severity of varicocele the ratio of smooth muscles to connective tissue did not change (17). Both studies hypothesized the reflux of blood caused the changes in the vessel walls or increase in pressure within the vessel lumen caused the structural changes. Both studies failed to mention why the initial presentation of high connective tissue content was found in the individuals with varicocele compared to the non-varicocele individuals.

An Indian study elicited that significant changes occurred not only in the outer layers of the vessel wall but also in the intimal layers (18). They agreed with Iafrate, with the increase in connective tissue content along with the disease severity advancement. A study on 20 patients with grade three varicocele concluded that the initial damage occurred in the endothelial layer of the vessel, later affected the intimal and muscle layers (19). According to this study, the final step was the replacement of muscle layers by collagen and intimal invagination of media forming pockets.

Genetic factors contributing to the formation of varicocele

Raman et. al, reported an increased prevalence of varicocele among the first degree relatives (20). Another study verified a prevalence of 45% of varicocele in first degree relatives, compared to the control prevalence of 11% (21). This was further established by a study on 92 patients with a threefold increase in inheritance of varicocele among the first degree relatives compared to the control group (22). Chromosomal abnormalities including Y chromosome microdeletions (23,24), polymorphisms of glutathionine transferase (25) and heat shock protein (26) and acid phosphatase (27) and mitochondrial (28) genes were found to be associated with varicocele in some populations. These genes serve a variety of functions to maintain the integrity of cellular structure (29). Hence, the pathophysiology of the structural derangement could be secondary to differential expression of genes related to matrix metalloproteinases, tissue inhibitors of metalloproteinases, inflammation, immune dysregulation or alterations of metabolic pathways. Nevertheless, functional studies on how these genetic factors cause the development of varicoceles are limited.

Conclusions

Certain anatomical features may predispose the pampiniform venous plexus on the left side to be more prone to varicocele than the right side. The structural changes of the pampiniform plexus may strongly contribute to the pathogenesis of varicocele. However, the underlying mechanisms of how these changes of the microstructural architecture of the pampiniform venous plexus leading to varicocele or the causality remain unclear. Furthermore, considering the presence of a familial inheritance pattern of varicocele, the study of the differential expression of the genes could elucidate the underlying mechanism of the ultrastructural changes.

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RESEARCH PAPERS

Morphology and Morphometry of prehistoric skeletal remains found in Potana, Sigiriya, Sri Lanka

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Abstract

This study explores morphology, morphometry of prehistoric skeletal remains found at *Potana*, Sigiriya, Sri Lanka that has been radio carbon dated as 4,000 years before present (YBP). The gender, age, stature, cause of death, health status, food habits and the way of life of *Potana* population have been explored by following the methods described in slandered text. One skeleton unearthed from context no 10 of the excavation presently displayed at National Museum, Colombo is of female sex and age at death is around 25-35 years. The calculated stature of the individual is 170 cm. Other skeleton found at the same context presently displayed at Sigiriya Museum is of male sex and determined age at death is around 25-30 years. The calculated stature of the male is 173.61cm. The skeleton excavated in context no 03 presently stored at Osteology Laboratory, Postgraduate Institute of Archaeology, University of Kelaniya is determined as female and age at death is around 35-40 years. In general, the prehistoric population that lived in *Potana* is further identified as a hunter gatherer population that shared many biometrics and socioeconomic characteristics among contemporary prehistoric populations that lived in Sri Lanka such as Bellan bandi Palassa, Batadomba lena, Beli lena, Fa Hien lena etc.

Keywords - Morphology, Morphometry, Prehistoric skeletal remains, Potana Sigiriya

Running Title - Prehistoric skeletal remains of Potana, Sigiriya, Sri Lanka

Introduction

The prehistory of Sri Lanka dates back to about 125,000 YBP (years before present) and possibly goes even as further as 500,000 YBP covering the Palaeolithic, Mesolithic and early Iron Age (Deraniyagala, 1992). The chronology of prehistoric human skeletal remains of Sri Lanka ranges around 40,000 YBP though prehistoric human skeletal remains of around 34,000 YBP onwards stand in a more complete form providing better and more informative evidence. *Fa-Hien* lena at Bulathsinghala (34,000 ± 5,400 C^{14} YBP), *Batadomba lena* near Kuruwita (28,500- 11,500 C^{14}Y BP), *Beli lena* at

Kitulgala (27,000 - 35,000 C^{14} YBP), *Alu lena* at Attangoda - Kegalle (10,500 C^{14} YBP) and *Bellan bandi palassa* at Balangoda (6,500 C^{14} YBP) etc mainly situated in the low country wet zone of the island have yielded human skeletal remains belonging to Sri Lankan prehistory (Kennedy, 1993).

Literature suggests that Sigiriya situated in the intermediate climatic zone in Matale district may have been occupied by *Homo sapiens* as far back as Mesolithic period of Sri Lanka (Adikari, 1998). There is evidence to suggest that Sigiriya had been continuously occupied by *Homo sapiens* during the prehistoric, protohistoric and historic eras (Adikari, 2008). Prehistoric cave site of *Potana* at Sigiriya has yielded human skeletal remains dating back to 4,000 C^{14} YBP and as such, is in agreement with the prehistoric human habitat at Sigiriya (Adikari, 1998). The two excavated human skeletons found in context No 10 from *Potana* are presently displayed at the Sigiriya Museum (human skeleton 1 / SK_1) and the National Museum of Sri Lanka (human skeleton 2 / SK_2). The base of skull with a few postcranial bones (human skeleton 3 / SK_3) excavated from context No 03 is presently stored at the Osteology Laboratory, Postgraduate Institute of Archaeology (PGIAR), University of Kelaniya.

The skeletal remains play a significant role in reconstructing the extinct past. The gender, age, stature, life style, dental health, cause of death etc would be determined by the detailed study of human skeletal remains (Bass, 2005). The prehistoric skeletal remains found in *Potana* have unique importance as the only specimens currently available in Sri Lanka belonging to the intermediate climatic zone. Initially, in the year 1994, excavated skeletal remains from *Potana* were identified as human and as dating back to 4,000 C^{14}YBP (Adikari, 1998). There are no reported detailed studies done on the prehistoric skeletal remains found in *Potana,* Thus, the study of morphology and morphomerty of available prehistoric skeletal remains at *Potana,* has its unique significance in view of obtaining a detailed description of our ancestors who had lived in the intermediate climatic zone at Matale district in the Mesolithic period of Sri Lanka.

The detailed study of morphology and morphometry of the prehistoric skeletal remains of *Potana* addresses the gender, age, stature, life style, health status etc.

Materials and Methods

The two excavated human skeletons found in context No 10 from *Potana* presently displayed at the Sigiriya Museum (human skeleton 1 / SK_1) and the National Museum of Sri Lanka (human skeleton 2 / SK_2) and the base of skull with a few postcranial bones (human skeleton 3 / SK_3) excavated from context No 03 presently stored at the Osteology Laboratory, Postgraduate Institute of Archaeology (PGIAR), University of Kelaniya were studied in detail. The purification and restoration of excavated bones were done following the methods described by Hillson (2002) and Bass (2005). The morphology and morphometry of the available

fragmented cranial & postcranial bones were studied by following the methods described by Bass (2005), Mays (1998), Brothwell (1981) and Williams et al. (1995). The detailed morphology and morphometry of permanent dentition were made by following the methods described in Hillson (2002).

According to the morphological features studied, the gender and the age at death of each skeleton were determined. Available fragmented pelvic, skull and long bones were used to determine the gender in the study (Bass 2005; Williams et al. 1995; Ubalaker and Buikstra 1994). Age of the skeletal remain has been determined by observing epiphyseal union of long bones, suture fusion of skull fragments, tooth eruption and wear on teeth (Hillson (2002) and Bass (2005). The stature calculation was done by using full long bones such as femur, tibia, humerus, ulna and radius based on regression formula derived by Trotter & Glesser (1952) for American Whites when full bone were available. The formulae described by Trotter & Glesser (1952) could not be applied directly because most of the long bones of skeletal remain were fragmented. Initially, reconstruction of the full length of the long bone: humeri and tibiae were carried out by using long bone fragments following the methods described by Krogman (1962).

Ethical clearance for the morphometrical & morphological study of skeletal remains excavated from Sigiriya *Potana* has been granted by the Ethics Review Committee of Faculty of Medical Sciences, University Sri Jayewardenepura, Sri Lanka (Ref No: 370 / 7)

Results and Analysis

Morphological analysis of prehistoric skeletal remains

The level of preservation of the three available prehistoric skeletons excavated from prehistoric site *Potana* was satisfactory to study the morphology and morphometry. The prehistoric skeleton (SK_1) presently displayed at Sigiriya museum, Sigiriya, prehistoric skeleton (SK_2) presently displayed at National Museum, Colombo and the prehistoric skeletal remains (SK_3) presently relocated at Osteology Laboratory, PGIAR were studied in detail. The morphological analysis was based upon the standards established by Bass (2005), Brothwell (1981), Mays (1998) and Williams et al. (1995).

Prehistoric skeleton (SK_1) presently displayed at Sigiriya museum.

The skeleton was found to be in resting on the right lateral aspect and double up sleeping position with knees flexed (Fig.1). The specimens were sub fossils with incomplete mineralization.

a. The Cranium

The cranium was resting on its right lateral aspect. The cranial vault has been severely fragmented and the left side of the cranium was exposed. The fragmented temporal, parietal and occipital bones have been preserved. The rectangular shaped left parietal bone fragment anteroposteriorly extended from coronal suture to lamboid suture. Laterally, it extended to the point of articulation with the squamousal part of the temporal bone. The coronal suture

was preserved for its medial 2/3 and lamboid suture was preserved for its medial 1/3. The appearance of the suture lines were serrated and closed. The thickness of parietal bone varied from its medial to lateral and ranged from 6 mm to 3 mm. The fragment of posterior-inferior part of right parietal bone was preserved.

The occipital bone was severely fragmented. The basilar and lateral parts were missing. The medium sized external occipital protuberance was restored and the nuchal lines were prominent in the occipital bone. Right lamboid suture was preserved for its lateral 1/3 while the left side was not found. The internal occipital crest was prominent on the endocranial surface of the mended occipital bone. The occipital bone was thick, attaining dimensions of 7.18mm at certain points.

Fragmented mastoid, petrous, squamous and the proximal part of zygomatic process of right temporal bone and mastoid, petrous and squamous parts of left temporal bone had been preserved. A decayed small part of the left petrous bone was found attached to sphenoid bone. A zygomatic process of temporal bone was clearly identified as it was extending above to the external auditory meatus. The mastoid processes were large in sizes, scored as type 4 according to the scoring system given by Ubelaker and Buikstra (1994) and were comparable with the male sex. The rectangular shaped bone fragment represented the middle part of the frontal bone was preserved. The identified fragment was found to be extended from coronal suture to orbital margin.

When considering the bones of the face, the maxilla was preserved. It was small to moderate in size. Intact eight permanent teeth, which were central & lateral incisors, canine, first and second premolars, first, second and third molars have been preserved at the left alveolar region. The anterior portion of right alveolar region bearing central & lateral incisors, canine, first and second premolars has been preserved as well.

b. The mandible

Two mandibular fragments have been preserved. An intact ramus and the distal fragment (5 cm) of the body of left fragment were available. The distal fragment of the body retained second premolar, first, second and third molars in their alveolar processes. The head and coronoid process were missing from the ramus. The available fragmented body and ramus was extremely robust. The available gonion was well developed and everted. The bony ridges and surfaces for the attachments of muscles such as masseter, temporalis and pterygoids have been well marked over the available fragmented ramus and body.

The right fragmented mandible was represented by the intact ramus with head and coronoid process and the fragmented body (2.5 cm) attached to ramus. The available fragments were robust. The body retained right third molar teeth in their alveolar process. The myolohyoid groove of the ramus was well marked in the right mandible.

c. Dental remains

Totally nineteen permanent teeth have been preserved and out of them fourteen

were maxillary teeth or upper teeth. Intact right and left central and lateral incisors, left and right canines, left and right first and second premolars and the left first molar (M_1), left second molar (M_2) and left third molar (M_3) molars of upper teeth in their alveolar processes of maxilla have been identified. The right third molar tooth was preserved and it was found to be not within the alveoli.

The upper teeth were moderate in size. The central incisors were larger than the lateral incisors and out of them the largest incisor was the left central. Incisors and canines were highly worn-out in condition. The cutting edges of the four incisors have been severely worn-out. In addition, shovel shaped incisors have been not found. The size of buccal cusps of first and second premolar was larger than lingual cusps on both sides. Attrition (wear) was not observable among the lingual and buccal cusps of all premolars. The size of the teeth reduced from second premolar to first premolar on both sides. The first and second molar showed four cusp pattern and "+" shaped grove pattern, while the third molar showed five cusp patterns. Although the dental wear was absent on the occlusal surfaces of second and third molars, the right first molar showed slight attrition over the lingual cusp. Dental dimensions have been observed to be high in the order of molar size as $M_1 > M_2 > M_3$ of the preserved upper teeth. There was no evidences of dental crowding, supernumerary teeth, shovel shaped incisors, artificial deformations, periodontal diseases and caries.

Intact lower teeth or mandibular teeth were the second right premolar, first, second and third right molars and left third molar. Their sizes were moderate to large. Attrition (wear) was not observable among the molars except the first right molar teeth which showed slight attrition over the lingual surface. Carious decay, periodontal diseases and artificial deformations have been not found. Dental dimensions have been reduced with molar size being $M_1 > M_2 > M_3$ for preserved lower teeth (Table 1 and Table 2)

d. Bones of the pelvic girdle

The pelvic bone has been severely fragmented. The identification of most of the individual bone fragments of the pelvic girdle was not possible. A bone fragment of right iliac bone with greater sciatic notch and small part of acetabulum has been preserved. A small part of left iliac bone with greater sciatic notch and auricular surface has been preserved. The greater sciatic notches were deep and narrow scored as 4 according to the scoring system given by Ubelaker and Buikstra (1994) and it was comparable with the male sex.

Prehistoric skeleton (SK_2) presently displayed at National Museum, Colombo.

The skeleton has been found to be in resting on right lateral aspect and double up sleeping position with knees flexed (Fig.2). The skeleton has been sub fossil in nature and severely fragmented. Handling of skeletal material for osteological analyses was not an easy task as most of the bones were fragile. Therefore the morphology was mostly recorded by looking at the

a. Cranium

The cranium has been found in resting on its right lateral aspect in the soil matrix. The left side of the cranium has been exposed and most of the available cranial bones such as left temporal, parietal and occipital bones have been severely fragmented and some fragments were found to be missing. As the cranium has been severely fragmented its reconstruction was not possible. The left fragmented frontal bone has been preserved to some extent. The supraorbital ridge of the available frontal bone was poorly developed and compared with the female sex.

A few fragments of parietal bones have been preserved. The existed rectangular shaped right parietal bone fragment extended anteroposteriorly from coronal suture to the point of articulation with the lamboid suture. The left parietal bone has been fragmented into more than four pieces. All the identified fragments have been robust and thick.

The occipital bone has been severely fragmented. The inter-parietal part of left squamous part of the occipital bone with condyles has been preserved. Slightly developed fragmented external occipital protuberance and superior and inferior nuchal lines have been identified and these were comparable with the female sex.

The mastoid, squamous and petrous parts of left temporal bone have been preserved. The zygomatic process has been broken from its origin. The mastoid process with small to moderate in size was broken from its base and scored as type 2 according to scoring system given by Ubelaker and Buikstra (1994). The petrous part of the temporal bone has been preserved except the area in between internal auditory meatus and medial portion of the petrous part was decayed.

When considering the facial skeleton, the alveolar portion of maxilla has been preserved. Thirteen permanent teeth which were in their alveoli processes have been preserved. They were the central and lateral left incisors, central right incisors, left canine, first, second left and right premolars, first, second and third right molar and first, second left molar teeth.

b. Mandible

The state of preservation of mandible was poor and it was partially mineralized. Two mandibular fragments have been preserved. The ramus and the body of left mandible has been preserved. The fragmented body contained central and lateral incisors, second premolar, first, second and third molar teeth. The fragmented ramus was represented by lower part which was about 2 cm in length. The gonion was slightly developed and slightly everted. Other fragment was represented by right body which extended from symphysis menti anteriorly to second molar teeth level posteriorly. The fragment was heavily mineralized. The restored chin of the mandible was medium in size and pointed.

c. Dental remains

Thirteen maxillary (upper) permanent teeth have been preserved. They were central and lateral left incisors, central right incisors, left canine, first and second left and right premolars, first,

second and third right molar and first, second left molar teeth within their alveolar processes. The upper teeth were moderate to large in size. Generally, anterior upper teeth showed pronounced attritions and the cutting blades have been severely worn out in all the upper incisors. The available right canine was highly worn out up to pulp cavity. The lingual and buccal cusps of first and second left premolars have been severely worn out. The attrition of right premolars was poor compared to left. Molars have been severely attrited and the level of attrition decreased from first molar to third in both sides. The identification of cusp pattern and grove patterns of molar teeth was not possible due to high dental attrition. Dental dimensions were high and the order of molar size has been $M_1 > M_2 > M_3$ for preserved upper teeth (Table 3.) There was no evidences of carious decays, periodental diseases, crowding, shovel shaped incisors, artificial deformations.

Ten mandibular (lower) teeth have been preserved. They were central and lateral left incisors, first right premolar, second left and right premolar, first, second, left and right molars and left third molar teeth within their alveolar processes. The first, second right incisors and left and right canines were broken from their roots. The lower teeth were moderate to large in size (Table 4.). In general, the lower teeth showed high attritions and anterior teeth (incisors) showed pronounced attritions. The lingual and buccal cusps of available premolars showed higher degree of attritions. The dental wear was high in the first, second left and right molars and the level of dental wear was decreased from first molar to third. The cusp pattern and grove patterns of molar teeth were not able to observe due to high dental attrition except left third molar tooth which showed 5+ cusp pattern. There was no evidence of crowding, supernumerary teeth, artificial deformations or caries.

d. Long bones

The long bones of upper and lower limb were severely fragmented. The available upper limb bones were fragmented at shafts of humeri, radi. and ulnae. The proximal end of the right humerus, with 1/3 of shaft intact and distal end of radii and ulnae were preserved. The left and right femora were severely fragmented. The bones of the leg were represented by left tibia broken into two fragments and the length of the restored bone was 36.3cm.

Prehistoric skeletal remains (SK_3) at Osteology Laboratory PGIAR

The skeletal remains (SK3) found in context no 03 of excavation of Potana cave site has been presently stored at Osteology Laboratory PGIAR. The skeletal remain consisted of fragmented cranium and a few post cranial bones. The vault of the cranium was missing and the cranial fossa was exposed. The preservation of available bones was poor and they were sub fossils. The mineralization process of bones was very high compared to other skeletal remains found in the excavation (Fig. 3.)

a. Cranium

The cranium was severely fragmented and the vault of the cranium was missing.

The fragmented occipital, temporal and parietal bones of cranium have been preserved. Two rectangular fragments of the parietal bone which represented the posterior inferior aspect have been preserved. It was robust and heavy and was 15 mm in thickness. The superior margin of restored fragment showed sharp cut.

Intact supraoccipital and squamous part of occipital bone was preserved. The most posterior aspect of foramen magnum was preserved and it was small to moderate in size. The internal occipital crest and internal occipital protuberance were slightly marked.

The left fragment of temporal bone was heavily mineralized and it represented the petrous and mastoid part. The external auditory meatus was broken vertically in midline and ear canal was exposed. The fragmented squamous, petrous and mastoid part of right temporal bone was found. The petrous part was highly mineralized. The external auditory meatus and the tympanic plate were fragmented and external ear canal was exposed. The styloid process was broken down from its base. Left and right mastoid processes showing posteromedially curved tips were small and were scored as type 02 according to scoring system given by Ubelaker and Buikstra (1994).

The alveolar portion of right maxilla was preserved. The most anterior part distal to the canine teeth was broken. Intact canine, first and second premolars, first and second molars within the alveolar process have been preserved and they were highly mineralized.

b. The mandible

The left and right mandibular fragments have been preserved. The right fragment was medium in size and extremely mineralized. The preserved ramus of right fragment which formed a fairly obtuse angle with the place of the corpus was short and moderate width. Gonion was inverted. The head was broken from the neck and the coronoid process was preserved. The body was thick and represented the small distal fragment (3 cm) attached to ramus. The alveolar margin of body was heavily mineralized and it contained third molar teeth. The space posterior to the alveolus of the right third molar was extensive.

The left half of the mandibular fragment was broken into three. It contained the ramus, base of the coronoid process and fragmented body attached to ramus. The body was small in size. The alveolar margin and mandibular teeth were not able to observe as alveolar margin of the body was highly mineralized.

c. Dental remains

A total of six teeth have been preserved. Out of them five were maxillary teeth. The upper right canine, first and second right premolars, first and second right molars have been preserved. Due to high attrition and heavy mineralization, the identification & evaluation of the general morphology of cusp patterns, groove patterns, wear on teeth etc and morphomerty (mesio-distal and bucco-lingual diameter) of upper teeth were not possible. The intact lower right third molar was large in size and was highly mineralized.

Reconstruction of full lengths from fragmented long bones

Reconstructed full lengths of right and left humerii and left tibia of SK1 and left humerus and tibia of SK2 are shown in Table 5 & 6. Distances (a-b, b-c, c-d, d-e, e-f, f-g) of humerus and tibia are shown in Bass (2005)

Reconstruction of stature

The stature of SK_1 and SK_2 was reconstructed by using measured full lengths and reconstructed full lengths of the long bones based on regression formula derived by Trotter & Glesser (1952) for American Whites. The estimated height of SK_1 is 173.32 cm and SK_2 is 170.03 cm (Table 7.)

Discussion

Prehistoric skeletal remains excavated from the *Potana* cave were found to be severely fragmented and fragile in nature which hindered the morphological and morphometric analyses. Human skeletal remains had to be differentiated from animal bones and this was done mostly by observing the anatomical features of the bones and overall size of the bones (Bass, 2005). However a proper separation could not be carried out at times due to smaller fragment size. In such instances, one way of differentiating human and animal bones is by the microscopic identification as documented by Mays (1998).

The determination of the age at death of the skeletal remains was done by observing the teeth eruption pattern and attrition of the available teeth. Mean life expectancy of *Potana* population could not be determined from this study due to the small sample size. However the calculated age at death of *Potana* male (SK_1) being 25 - 30 years, female (SK_2) being 25 - 35 years and female (SK_3) being 35 - 40 years were within the range of age at death of contemporary prehistoric population that lived in Sri Lanka (Hawkey, 2002; Kennedy, 1965). It is also in keeping with the recorded age for prehistoric world population (25 - 40 years).

Under normal circumstances, pelvic bones give the best evidence for gender determination (Bass, 2005; Williams et al. 1995). Therefore although fragmented, the pelvic bones and cranial bones were used to determine the gender. Although molecular methods of gender determination based on the presence of different sized alleles of the amelogenin gene on nuclear chromosomes X and Y could be used to determine gender more accurately than the conventional osteology method (Hummel and Herrmann, 1991; Schultes et al. 1997; Michaela and Eva Drozdová, 2008), for this it is necessary to extract ancient DNA from the fossil remain as the first step to confirm the gender of the individual determined by the study based on conventional morphology and morphometry.

The estimated height of *Potana* male (SK_1) (173.32 cm) and female (SK_2) (170 cm) was higher than the reconstructed documented height of *Balangoda* male (165.2 cm) and reconstructed height of *Balangoda* female (152.2 cm) (Deraniyagala, 1992). The average stature reported for the historic male who lived in *Naipena Guhava* (Cobra hood cave) at Sigiriya being 152 cm (n=5) (Chandrasekara and Wikramanayake,

1992) and the reported mean height for *Vedda* male being 156.62 cm ± 5.59 (n = 12) (Wikramanayake and Wikramanayake, 1992) is shorter than that of *Potana* male. Kennedy (1965) has reported that *Balangodese* group of people (Sri Lankan prehistoric population) was taller in height [(males: 5 feet 11 inches (164.7 cm); females 5 feet 5 inches (164.0 cm)] than the present Sri Lankans. This is comparable with the male and female of *Potana* prehistoric population who were taller than the present-day Sri Lankans:- male: 163.6 cm ± 6.9; female: 151.4 cm ± 6.4 (Ranasinghe et al. 2011). Findings of stone tools, bone tools and large amount of mollusca shells and bones of fish, reptiles, birds and mammals at the excavation in context no 3 and 10 support that the prehistoric population at *Potana* might have practiced carnivorous food habits with high amount of protein intake (Ranasinghe, 2009). The high animal protein intake may have influenced the increased height of *Potana* population.

Since there were no cranial bones with preserved landmarks in the collection, it was not possible to calculate cephalic index, nasal index, prosopic (facial) index etc. However certain measurements such as palatal and mandibular measurements could be obtained from the available mandible and palate. The measured palatal metrics (palatal length and breadth) of *Potana* population was within the range of the reported metrics of Balangoda population (Kanthilatha, 2012; Hawkey, 2002) and these measurements were larger than the reported measurements of modern Sri Lankans (Kanthilatha, 2012).

In case of metrical data of the dentition, an important character of all the measured molar teeth was that the bucco-lingual diameter of the occlusal surface exceeded the mesio-distal diameter (Table 4.3, 4.4, 4.5 and 4.6). This contrasts with the specimens of *Batadomba lena* and *Beli lena* where mesio-distal diameter of the molar was longer than the bucco-lingual diameter (Kennedy et al., 1971). However the molar measurements of *Balangoda* dentition are similar to the present study (Kennedy et al., 1971). The order of molar size reduction from first molar (M_1) > second molar (M_2) > to third molar (M_3) observed in *Potana* specimens in this study is similar to the molar size reduction seen in *Batadomba lena* and *Beli lena* specimens (Kennedy et al., 1971). However, the order of molar size reduction in the *Balangoda* series is recorded as $M_2 > M_1 > M_3$ (Kennedy et al., 1971).

When molar crown area of *Potana* specimens is compared with the reported numbers of Lukacs (1984) and Kennedy et al., (1971), values of *Potana* specimens could be placed near the values of *Batadomba lena, Beli lena* and *Bellan bandi Palassa* series. *Potana* dental measurements further support that Sri Lanka's Pleistocene hominids share features of large teeth (megadont) as stated by Hawkey (2002).

In *Potana* dental remains, the attrition of the incisors and canines was higher than the attrition in molar and premolar teeth. Similar type of attrition pattern was recorded in anterior teeth (incisors and canines) of dental remains found in *Pomparippu* and *Balangoda* populations (Lukacs, 1973; Kennedy et al., 1987).

Generally, this evidence indicates that the anterior teeth have been used more than the posterior dentition. The cause for the pronounced wear on anterior teeth might be due to their food habits or that the incisors and canines were used as tools to manipulate and hold various objects.

Kennedy et al., (1987) reported that pathological condition of dental remains such as carious decay and periodontal diseases were absent in *Balangoda* population. Similar observations were made by me in *Potana* specimens. Higher incidence of dental caries and periodontal disease of *Popmparippu* and *Pellemalala* populations revealed that these populations had poor dental health than the *Potana* and *Banlangoda* populations (Lukacs, 1973; Ranaweera, 1992).

The dental evidence of *Bellan bandi Palassa* (Kennedy, 1965; Kanthilatha, 2012), *Batadomba lena* (Kennedy et al., 1971), *Beli lena* (Kennedy et al., 1971) and *Pellamalala* (Ranaweera, 1992) showed various discolourations similar to the present study. Discolouration pattern seen as uniform pale brown color at the neck of the teeth and dark brown or black pigments over the crown could be due to soil conditions in the burial site (Mays, 1998).

The dry climatic condition that had being existing at *Potana* may have been unfavorable for the vegetation. They may have had to find their daily food from the alternative sources such as animal flesh including small mammals (hare, monkey and wild boar) and large mammals (gaur, deer etc) (Adikari, 1998). The faunal evidence of fresh water crab (Paradoxrus spp.), snails (Acavus spp., Paludomus spp. and Pila spp.), the bivalve (Anodon spp.) and remains of fresh water fish revealed that the fresh water invertebrates and vertebrates too were included into their diet (Ranasinghe, 2009). All the above evidence points to the subsistence pattern of *Potana* man as hunting, gathering and fishing which had been the way of life of other prehistoric populations that lived in Sri Lanka such as *Bellan bandi Palassa* (Kennedy 1965; Kanthilatha, 2012), *Batadomba lena* (Kennedy et al., 1971), *Beli lena* (Kennedy et al., 1971) *Pellamalala* (Ranaweera, 1992) and *Miniethiliya* (Kulatilake, 2012).

The age at death, height, food habits, life style, health status and such other characters of the prehistoric population of *Potana* were able to be discovered by detailed study of morphology and morphometry of skeletal remains (Bass 2005; Brothwell, 1981; Mays, 1998). The genomic study using ancient skeletal remains revealed genetic information that can be used to explore population affinities which cannot be achieved by the conventional study of morphometry and morphology of skeletal remains.

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Tables

Table 1. The dental measurements of upper teeth of SK_1

Teeth Type	Mesio-distal diameter (mm)	Bucco – lingual diameter (mm)	Crown index (MD/BLX 100)	Crown module (MDXBL)	Robustness value (MD+BL/2)
Left upper incisor 1	8.16	2.6	313.8	21.2	5.4
Right upper incisor 1	8.06	2.64	305.3	21.3	5.4
Left upper incisor 2	5.31	2.43	218.5	12.9	3.9
Right upper incisor 2	5.75	2.18	263.8	12.5	4.0
Left upper canine	9.04	2.61	346.4	23.6	5.8
Right upper canine	7.39	3.75	197.1	27.7	5.6
Left upper premolar 1	6.4	9.28	69.0	59.4	7.8
Right upper premolar 1	6.47	8.86	73.0	57.3	7.7
Left upper premolar 2	6.62	9.58	69.1	63.4	8.1
Right upper premolar 2	6.03	9.65	62.5	58.2	7.8
Left upper molar 1	NA	NA	NA	NA	NA
Right upper molar 1	10.61	11.68	90.8	123.9	11.1
Left upper molar 2	NA	NA	NA	NA	NA
Right upper molar 2	9.49	10.89	87.1	103.3	10.2
Left upper molar 3	8.76	10.1	86.7	88.5	9.4
Right upper molar 3	9.06	10.5	86.3	95.1	9.8

NA - not available

Table 2. The dental measurements of lower teeth of SK_1

Teeth Type	Mesio-distal diameter (mm)	Bucco – lingual diameter (mm)	Crown index (MD/BLX 100)	Crown module (MDXBL)	Robustness value (MD+BL/2)
Right lower molar 1	10.05	11.24	89.4	113.0	10.6
Right lower molar 2	9.84	10.77	91.4	106.0	10.3
Right lower molar 3	9.68	10.55	91.8	102.1	10.1

Table 3. The dental measurements of upper teeth of SK_2

Teeth Type	Mesio-distal diameter (mm)	Bucco – lingual diameter (mm)	Crown index (MD/BL X100)	Crown module (MDXBL)	Robustness value (MD+BL/2)
Left upper incisor 1	8.11	2.64	307.2	21.4	5.4
Right upper incisor 1	8.23	2.16	381.0	17.8	5.2
Left upper incisor 2	6.55	2.6	251.9	17.0	4.6
Right upper incisor 2	NA	NA	NA	NA	NA
Left upper canine	7.52	5.52	136.2	41.5	6.5
Right upper canine	NA	NA	NA	NA	NA
Left upper premolar 1	6.56	8.52	77.0	55.9	7.5
Right upper premolar 1	6.67	9.3	71.7	62.0	8.0
Left upper premolar 2	4.94	9.01	54.8	44.5	7.0
Right upper premolar 2	6.41	9.65	66.4	61.9	8.0
Left upper molar 1	10.74	11.19	96.0	120.2	11.0
Right upper molar 1	10.56	10.81	97.7	114.2	10.7
Left upper molar 2	10.16	11.07	91.8	112.5	10.6
Right upper molar 2	10.36	11.69	88.6	121.1	11.0
Left upper molar 3	NA	NA	NA	NA	NA
Right upper molar 3	8.33	12.26	67.9	102.1	10.3

NA - not available

Table 4a. The dental measurements of lower teeth of SK2

Teeth Type	Mesio-distal diameter (mm)	Bucco – lingual diameter (mm)	Crown index (MD/BLX100)	Crown module (MDXBL)	Robustness value(MD+BL/2)
Left lower incisor 1	7.1	2.64	269	18.7	4.9
Right lower incisor 1	NA	NA	NA	NA	NA
Left lowerincisor 2	6.87	2.6	264	17.9	4.7
Right lower incisor 2	NA	NA	NA	NA	NA
Left lower canine	NA	NA	NA	NA	NA
Right lower canine	NA	NA	NA	NA	NA
Left lower premolar 1	NA	NA	NA	NA	NA
Right lower premolar 1	5.15	6.07	85	31.3	5.6
Left lower premolar 2	8.14	7.2	113	58.6	7.7
Right lower premolar 2	8.06	7.25	111	58.4	7.7
Left lower molar 1	10.17	10.54	96	107.2	10.4
Right lower molar 1	10.15	11.34	90	115.1	10.7

NA - not available

Table 4b. The dental measurements of lower teeth of SK_2

Teeth Type	Mesio-distal diameter (mm)	Bucco – lingual diameter (mm)	Crown index (MD/BLX100)	Crown module (MDXBL)	Robustness value (MD+BL/2)
Left lower molar 2	9.74	10.67	91	103.9	10.2
Right lower molar 2	9.56	10.7	89	102.3	10.1
Left lower molar 3	9.68	10.51	92	101.7	10.1
Right lower molar 3	NA	NA	NA	NA	NA

NA - not available

Table 5. Reconstructed long bone lengths of SK_1

Long bone fragment	Measured distance of the bone (mm)	Total length of the bone (cm)
Proximal end of left humerus	a-b = 36.72	32.09
Proximal end of left humerus	b-c = 24.90	32.05
Distal end of left humerus	d-e = 20.46	32.17
Distal end of left humerus	e-f = 17.60	32.13
Distal end of right humerus	d-e = 20.56	32.07
Distal end of right humerus	e-f = 17.50	32.45
Proximal end of left tibia	a-b = 27.05	34.32
Distal end of left tibia	f-g = 11.35	34.40

Table.6 Reconstructed long bone lengths of SK_2

Long bone fragment	Measured distance of the bone (mm)	Total length of bone (cm)
Proximal end of left humerus	a-b = 37.05	32.3
Proximal end of left humerus	b-c = 23.7	31.1
Proximal end of left tibia	a-b = 27.5	36.2
Distal end of left tibia	f-g = 18.3	36.3

Table 7. Estimated stature of SK_1 and SK_2

Specimen	Long bone	Total length of the bone (cm)	Reconstructed stature (cm)
SK1	Left femur	46.0	172.25
	Right radius	27.8	184.78
	Left radius	27.3	182.88
	Right humerus	32.2	171.33
	Left humerus	32.1	170.51
	Left ulna	27.6 (approxi)	179.10
	Right ulna	28.0 (approxi)	180.83
	Left tibia	34.4	165.83
Average stature of SK1			**173.32**
SK2	Left humerus	31.7	169.50
	Left tibia	36.3	168.46
	Right tibia	38.5	175.10
Averagestature of SK2			**170.03**

Figures

Fig. 1. Prehistoric skeleton (SK_1) presently displayed at Sigiriya museum

Fig. 2. Prehistoric skeleton (SK_2) presently displayed at National Museum, Colombo

Fig.3. Prehistoric skeletal remains (SK_3) at Ostoeology Laboratory, PGIAR

Comparision of the knee joint alignment in sportsmen and controls

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Running title: knee alignment in rugger rites and controls

Abstract

The alignment of the knee joint described as the angle formed by the femoral shaft and the tibial shaft at the knee. It is of significance due to its association with different disease conditions affecting the knee. Muscle strength affects alignment of the knee, therefore we measured the knee alignment of Peradeniya University rugby team and compared with a control.

All 27 individuals in the university rugby pool, all of them being male, were included in the study. Their weight and height were measured in kilograms and meters using standard measuring scales and the BMI was calculated using the Quetelets index. Anterior plane knee alignment was measured using a handheld metal goniometer. The other group consisted of 25 male student volunteers that do not engage in sporting activities.

The rugby players had a mean knee alignment angle of 181.96° (± 3.4) and the control sample had a mean of 183.67° (±3.75). The difference observed in the means was statistically significant (p=0.45) with the rugby players' having more varus oriented knee joints.

The rugby players in our study showed a more varus oriented knee joint alignment than the controls. The varus orientation seen in these ruby players at this early age could be a cause for development of knee joint OA in the future due to the excessive strain placed on the medial compartment of the knee joint.

Introduction

The alignment of the knee joint described as the angle formed by the femoral shaft and the tibial shaft at the knee. It is of significance due to its association with different disease conditions affecting the knee (1). For example knee joint alignment is considered as a prognostic factor in both osteoarthritis and rheumatoid arthritis. Problems in the alignment: mal-alignment causes the weight distribution across the knee to change thereby causing undue stress on areas of the knee. This is seen commonly in knee osteoarthritis where mal-alignment of the knee towards the medial side causes increase in the severity of osteoarthritis of the medial compartment of the knee.

The factors that determine the alignment of the knee are many, being genetic factors, body mass index (BMI), laxity of the joint and muscle strength (2-4). While some of these factors maybe none-modifiable, some such as BMI and muscle strength can be changed.

Individuals engaged in sports on a regular basis generally have good muscle strength compared to an age matched sample that does not engage in sport regularly. Rugby is a sport which requires a great deal of muscle strength and those who engage in this sport have good lower limb muscle strength (5). However it is seen that some elite athletes and sportsmen tend to develop OA in later life and knee joint OA is the commonest condition (6). It is further stated that the overall muscle strength and fitness of the body prevents or decreases the rate of physical decline in such persons (6).

With this background it was the objective of this study to measure the knee joint alignment of Peradeniya University rugby team and compare with a group of students who do not engage in sporting activities on a regular basis in order to observe if alignment has a role to play in the development of OA in sportsmen.

Materials and Methods

The study was conducted at the Faculty of Medicine, University of Peradeniya. Ethical clearance was granted by the institutional review board, Faculty of Medicine, University of Peradeniya (No: 2008/EC/75). Informed, written consent was obtained from each participant.

All 27 individuals in the university rugby pool, all of them being male, were included in the study. Those with serious injuries to the hip knee or ankle and those with a history of surgery to the lower limb were excluded from the study. Their weight and height were measured in kilograms and meters using standard measuring scales and the BMI was calculated using the Quetelets index (7). Anterior plane knee alignment was measured using a handheld metal goniometer using the method described by Kraus et al (8). Readings were recorded up to 1 degree with the subject in an erect standing position, bare foot with toes placed forward and feet shoulder-width apart. The centre of the patella was located and marked with a pen. The center of the goniometer was placed on the center of the patella, and the arms of the goniometer were extended along the thigh visually bisecting it and along the axis of the lower leg along the first 4-5 cm of the subcutaneous border of the tibia in line with the middle of the ankle. The measurement was taken on both knees. Three consecutive measurements were taken by two separate investigators blinded to each other's findings. No significant inter or intra-observer variability occurred. The other group consisted of 25 male student volunteers that do not engage in sporting activities. This control sample was selected from a large sample (210) from a group of volunteers selected for a previous study (9). The weight, height and knee joint alignment of the controls were measured using the same instruments and methods.

Results

Sample from the rugby players consisted of 27 male individuals with an average age of 22.5±1.4 years. The control sample consisted of 25 males with an average age of 23.07±0.95 years. The

mean BMI of the rugby players was 24.51(±3.4) and that of the control group was 21.18 (±1.3). The difference in the mean BMI was statistically significant. The rugby players had a mean knee alignment angle of 181.96° (± 3.4) and the control sample had a mean of 183.67° (±3.75) (Figure 1). The difference observed in the means was statistically significant (p=0.45) with the rugby players' having more varus oriented knee joints.

Discussion

The rugby players in our study showed a more varus oriented knee joint alignment than the controls. An alignment study done on soccer players report similar findings in male soccer players and further report that athletes in general have more varus oriented knee joints (10). This is varus orientation is thought to be due to the greater strains that the knee is subjected to during sporting activities. It is interesting to see that those athletes who engage in sports that require lifting of heavy weights and building up of muscle strength have more varus oriented knees than those that require less of these attributes (10). The BMI of the rugby players was higher than the controls. BMI though a good measure of the body fat percentage is not a good indicator in instances where muscle mass is high as seen in athletes. The high BMI recorded in these rugby players is probably due to the higher muscle mass. However further evaluation of this measurement was beyond the scope of this study.

One limitation of this study is that the gold standard for the measurement of knee joint measurement was not used for this study. The gold standard being the angle measured on a full length antero-posterior (AP) weight bearing limb radiograph, which extends from the pelvis to the ankle joint (1). However this method exposes the participant to large amounts of radiation and cannot be utilized in a study of this nature. Kraus, et al., in 2005 concluded that knee alignment assessed clinically by goniometer correlated with the angle measured on the full-limb radiograph and that this alternative method was useful and appropriate in studies (8).

The varus orientation seen in these ruby players at this early age could be a cause for development of knee joint OA in the future due to the excessive strain placed on the medial compartment of the knee joint. However, long term follow-up and serial measurement of knee joint alignment is required to prove this association.

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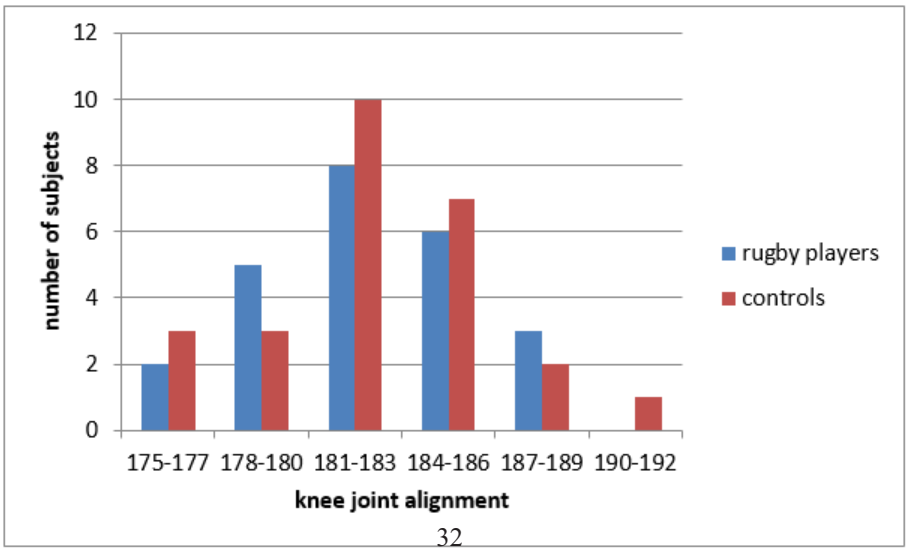
Figures

Figure1. Knee joint alignment in the rugby players and controls



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Minimal access oesophagectomy; review of out come

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Abstract

Minimal access oesophagectomy may be performed by thoraco-laparoscopic or laparoscopic transhiatal techniques. Thoracoscopy gives a better visualization of intra-thorasic anatomy than trashiatal approach but has the disadvantage of making lung collapse during surgery a requirement. A comparison was done of both techniques. Surgery was completed safely by both methods. Thoracoscopy took more time and patients were electively ventilated for one day whereas transhiatal group were extubated in the immediate post operative period. Two patients of thoracoscopy group required re-intubation for lung infections and one of them died. If post operative pulmonary care is improved thoracoscopy may be the better technique as it allows more precise oncologically acceptable dissection.

Keywords - oesophagectomy, minimal access

Introduction

Oesophagectomy is the surgical treatment for resectable oesophageal carcinoma1. There is a significant morbidity and an associated mortality1,8. It may be done with a thoracotomy and a laparotomy with an intrathorasic anastomosis; two stage oesophagectomy. In three stage procedure the anastomosis is performed in the neck[1].

Thoracotomy contributes significantly to the morbidity. It may lead to many respiratory complications. To minimize this transhiatal blunt oesophagectomy was introduced by Orringer; the oesophagus being mobilized through the hiatus with out vision. Even though thoracotomy is taken away there is a risk of haemorrhage and the resection may be inadequate and will not allow any lymph node clearance[1,8].

Minimal access oesophagectomy allows the procedure to be done without thoracotomy and laparotomy[1,2,3,4,5,6,7]. This may be done in two ways.

1. Laparoscopy, thoracoscopy and neck incision
2. Laparoscopy, transhiatal minimal access mobilization of oesophagus and neck incision

Objectives

Comparison of the surgical technique used in thoraco-laparoscopic oesophagectomy and laparoscopic transhiatal oesophagectomy.

Method

The patients undergoing oesophagectomy were performed by minimal access technique. The patients with tumours in lower end were done by transhiatal approach while others by thoraco-laparoscopically

The following data were collected

1. blood loss
2. duration of surgery
3. conversions
4. post operative out come

Results

Twenty patients underwent surgery and four were thoraco-laproscopic and sixteen transhiatal. Ten were males.

Comparison of technique

In both situations mobilization of stomach was laparoscopic with five ports. The thorasic oesophagus was mobilized by thoracoscopy in one group and via hiatus in the other group. The last stage of neck dissection was same in both groups.

The thoracoscopy was done as first stage in thoraco-laparoscopic group. Patient was placed in semi-prone position and surgery performed using three ports. Space for dissection was obtained by a capnothorax with an insufflation pressure of 8mmHg. Prone position allows the collapsed lung to fall away from the field of dissection. Once thorasic oesophagus was mobilized patient was placed supine for laparoscopy.

In all patients a neck incision was made on left side to mobilize cervical oesophagus. Then the oesophagus was transected and a naso-gastirc tube anchored to lower end. A minilap of about 4cm was made, stomach held with a Babcock grasper to pull out stomach and oesophagus. Following division of oesophagus a stomach tube was constructed and a pyloromyotomy done. The stomach tube is pulled up to neck and oesophago-gastirc anastomosis performed.

The following tables compares the time taken and blood loss for each stage.

Table 1-Thoraco-laparoscopy

Table 2-Laparoscopic transhiatal

Conversions to open surgery

In both groups a mini laparotomy was electively made to construct the stomach tube. The other alternative is to use laparoscopic stapling which may add a cost of about 50,000 to 75,000 rupees for stapler guns and reloads.

In two patients of transhiatal group it was difficult to get full mobilization of oesophagus. The mobilization was completed transhiatally by blunt dissection through laparotomy. Two patients with tumours at gastro-oesophageal junction were found to unresectable and procedure abandoned.

All patients who underwent transhiatal dissection were extubated at end of procedure. In the thoraco-laparoscopy group all four patients were ventilated for twenty four hours. Two of them required re-ventilation secondary to respiratory tract infections. One of them died after two weeks with multi organ failure.

Discussion

By performing oesophagectomy by minimal access technique its possible to do avoid large incisions. By avoiding an incision post operative pain become less which allows early mobilization. When pain is less breathing difficulties are less and respiratory complications are reduced.

To compare thoraco-laparoscopic and transhiatal approaches by the technique the former takes extra time for positioning. In addition it involves collapsing the lung. The thoracoscopy patients were electively ventilated for twenty four hours where as the trashiatal patients were extubated at end of procedure. Furthermore two patients of thoracoscopy group were reintubated due to chest infections and one died after two weeks. Transhiatal technique may be associated with a lesser incidence of post operative chest complications.

However during thoracoscopy we do not use lung collapse by blocking ventilation by double lumen endotracheal tube; a single lumen tube is used and a partial lung collapse is obtained by a capnothorax. This has proved to be an effective and easier technique[9,10,13].

Further the standard positioning in thoracoscopic oesophagectomy is full prone4,8. However we use a semi-prone position which is proven to have many advantages over full prone position[9,11,12]. Thoracoscopy has the advantage of having a greater vision of all surrounding anatomy allowing a controlled and safe dissection. This technique could be used for tumours at any level whereas the transhiatal technique should be reserved for lower end tumours[8,9]. Thoracoscopic dissection has more potential for better lymph node dissection[8]. Out of the patients we operated in a complete transhiatal dissection was not possible and we had to perform a blunt dissection. The problem in thoracoscopy vision of the surrounding anatomy is limited[9]. The space available for instruments is also limited. In thoracoscopy to achieve complete dissection is easier as its done under direct vision with more space for dissecting instruments.

The time taken in thoracosco-laparoscopy is more mainly due to the time taken for repositioning. Blood losses are comparable.

Conclusions

Thoraco-laparoscopy and laparoscopic transhiatal techniques can be used safely for oesophagectomy. The former allows a better visualized precise anatomical dissection. However it is necessary to collapse the lung for thoracoscopy which may increase the risk for chest infections. If pre and post operative pulmonary care can be improved to minimize chest complications thoracoscopy would be the better technique as it allows a more precise oncological dissection.

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Tables

Table 1-Thoraco-laparoscopy

	Thoracoscopy	Turning patient	Laparoscopy	Neck phase	Minilap and anastomosis
Time (min)	90-120 Average -100	Average -30	60-120 Average -90	30-45 Average -40	30-40 Average -35
Blood loss(ml)	<75	-	<50	<50	<50

Table 2-Laparoscopic transhiatal

	Laparoscopy	Transhiatal	Neck phase	Minilap and anastomosis
Time (min)	70-130 Average -85	75-120 Average -90	35-45 Average -40	40-50 Average -45
Blood loss(ml)	<50	Average -100	<50	<50

An audit on medical students' exposures to occupational hazards during cadaveric dissections

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Abstract

Introduction

We intended to study the prevalence of occupational hazards in the anatomy laboratory and the safety measures taken by students.

Methodology

An audit was conducted among two batches of medical students, soon after the completion of the anatomy curriculum. Exposures, practices, health conditions of the students, their suggestions to improve safety measures and self-reported engagement in dissections in each session (in a ten-point Likert scale) were assessed using a validated self-administered questionnaire.

Results

Of 196 respondents, 50%(n=98) were males. Mean age was 21.8±1.1 years. During their first-year dissections, 15.8%(n=31) had cut injuries, 86.7%(n=170) had skin contact with cadaver fluids while 5.6%(n=11) had eye splashes. Of those with skin contact, 43.5%(n=74) washed immediately. Of those who had eye splashes, only 18.2%(n=2) washed immediately for 20 minutes as recommended. Nine students reported new nail infections, seven developed allergies to cadaver fluids and 15 developed skin rashes during the period of dissections. Self-reported engagement in dissections positively correlated with the frequency of skin contact with cadaver fluids ($r=.161, p=0.035$), but not with the frequency of cut injuries ($p>.05$) or eye splashes ($p>.05$). Students suggested the following safety measures: 63.3%(n=72)-lab coats, 55.6%(n=109)-masks, 16.8%(n=33)-goggles, 43.9%(n=86)-a lecture on lab safety, 44.4%(n=87)-a workshop and 40.3%(n=79)-a formal safety protocol.

Conclusions

Students are exposed to numerous occupational hazards in the anatomy laboratory. Inadequate adherence to internationally recommended laboratory safety measures may increase the risk of occupational hazards.

Keywords

anatomy, laboratory, health hazards, occupational exposure, formalin

Introduction

Cadaveric dissections play an integral role in various medical disciplines [1-3]. Dissections do not merely improve the theoretical knowledge, but also improve students' manual dexterity, three-dimensional comprehension, professional behaviour and create a humane concept of life and death [3]. But this does not come without risks. Fresh cadavers act as an excellent culture medium for many pathogens including bacteria (Mycobacterium tuberculosis, Salmonella typhi, Brucella spp), viruses (hepatitis B, C and Human Immunodeficiency Virus), fungi and prions [1, 4, 5]. Some studies have identified the presence of pathogenic agents even in formalin preserved cadavers after many months of preservation [1, 2]. The efficacy of disinfectants used during fixation of cadavers are not well understood [6]. Hence, the method of preservation and the age of the cadavers may create a “false sense of security" [5]. Therefore, every cadaver should be considered as an infectious material [1, 4-6].

Various chemicals used in dissections such as fixatives, disinfectants and buffers pose potentially harmful health effects [1-3, 5, 6]. Some of these agents may be flammable, explosive, acidic or carcinogenic [5]. Formalin is one such preservative which is flammable and classified as a ''probable human carcinogen'' [7, 8]. Carcinogenic properties of most of the chemicals used in cadaveric preservations are largely unknown [6].

The students and ancillary staff are the most involved with dissections, therefore amenable to health risks [1-3, 5]. Studies demonstrate a substantial lack of awareness on health hazards among students [1, 3, 5] and the awareness is significantly lower among the participants in anatomy laboratories when compared to other laboratories which handle cadavers [2]. Establishment of a healthy environment within the laboratory with safety measures and proper codes of conduct have shown to minimize potential injuries to the involved individuals [1, 2, 5].

Safety protocols for laboratories conducting cadaveric studies vary widely among different communities [5]. At the time of designing this study, there were no such protocols in many leading Universities in Sri Lanka. To develop protocols, it is essential to understand the existing practice, encountered occupational hazards and the safety procedures followed by the students. Hence, the purpose of this audit was to identify the potential occupational hazards encountered by the medical students during their cadaveric dissections and to find out their practices following such incidents.

Methods

An audit was conducted among two batches of medical students of the Faculty of Medicine, University of Colombo, Sri Lanka. They were recruited for the study soon after the completion of their anatomy curriculum. The study was carried out from August to September 2018. The audit conformed to the guidelines of the Declaration of

Helsinki [9]. All the students were invited for the study. Written informed consent was taken prior to data collection from the participants. Exposures, practices, prevention methods, health conditions of the students, their suggestions to improve safety measures and self-reported engagement in dissections during each session were assessed using a self-administered questionnaire. Exposure was tested using 'yes' or 'no' responses, while practices and safety measures were tested by selection of a single response out of a list. Students themselves reported how frequently they were involved in the dissections during the allocated time for practical sessions (self-reported engagement). Frequency of engagement in dissections was measured using a ten-point Likert scale from 1 to 10 (1= never, 10 = always). A section on ways to improve the current practice was included. The face validation was obtained through a pilot test. Data was analysed using SPSS version 20. Standard descriptive statistics were used for the analysis of the gathered data at a priori alpha of .05

Results

In this study, a total of 196 students were assessed. Male to female ratio was 1:1. Mean age was 21.8±1.1 years.

Reported injuries

During their first-year dissections, 31 (15.8%) had at least one cut injury with a sharp object (scalpel or a sharp body part such as the cut end of a rib). Following scalpel cut injuries only 7 (22.6%) received post exposure tetanus prophylaxis. Majority (n=170, 86.7%) had skin contact with cadaver fluids at least once during dissections. The mean frequency of a medical student having skin contact with cadaver fluid during a period of one year was 9±7. Of those with skin contact, only 74 (43.5%) washed immediately. Ninety-two (54.1%) waited until the end of the dissection session to wash the area of skin that was in contact with cadaver fluids. A total of 11 (5.6%) students had eye splashes with cadaver fluids. Of those who had eye splashes, only two (18.2%) washed immediately for 20 minutes as per the recommendations [10, 11]. Eight (72.7%) students washed eyes immediately with running water, however for a short duration (less than 20 minutes) following splashes. One student (9.1%) waited until the end of the dissection to wash eyes following a minor splash.

Reported health conditions

Nine (4.6%) students developed new nail infections during the first year. Seven (3.6%) students developed allergies to cadaver fluids. None of them reported anaphylaxis or severe allergies necessitating hospital admissions. Fifteen (7.7%) developed skin rashes during the period of dissections. Majority of these skin rashes developed in the areas that were more prone to come in to contact with cadaver fluids such as exposed areas of the hands and the legs.

Students' practices during dissections

Mean score of the self-reported engagement in dissections was 7/10 (SD=3/10). Self-reported mean frequency of disposing scalpels outside the sharp bin was 3/10 (SD=3/10). One student stated that he/she has never seen the sharp bin during the whole first year. Everyone in the study population had touched the cadavers without wearing gloves at least once during their first year. Three (1.5%) students stated that they were unaware that cadaver fluid was harmful. A Pearson's product-moment correlation coefficient test was conducted to investigate the relationship between the self-reported engagement in dissections and the frequency of getting injuries in the laboratory. Preliminary analyses were conducted to ensure no violations of the assumptions of normality, linearity and homoscedasticity. There was a weak, positive correlation between the self-reported engagement in dissections and the frequency of skin contact with cadaver fluids (r=.161, n=196, p=0.035) (Figure 1). But no such correlations were identified between the engagement in dissections and the frequency of cut injuries (p>.05) or frequency of eye splashes (p>.05). Independent sample t-tests did not show significant differences of having cut injuries, cadaver fluid contacts with the skin or eye splashes between males and females (p>.05).

Suggestions by the students

Majority of the students (n=72, 63.3%) suggested lab coats to be worn compulsorily in the dissection hall. This was followed by the suggestion of the safety measures: wearing face masks (n=109, 55.6%), a workshop to improve awareness of occupational hazards (n=87, 44.4%), a lecture on lab safety (n=86, 43.9%), a formal safety protocol to be put up as a poster in the dissection hall (n=79, 40.3%) and wearing eye protective goggles (n=33, 16.8%). Further, they requested a proper training on and adequate facilities for handwashing during the first year.

Discussion

At an anatomy laboratory a handler gets exposed to hazardous material through direct contact, inhalation or by contact with the infected instruments [12]. Biosafety is the practice used to contain infectious organisms in the laboratory environment and minimize the risk of exposure to laboratory handlers [6, 13]. Biosafety in microbiological and biomedical laboratories (BMBL) in the United States defines biosafety level two as handling the cell cultures of humans and other primates, which include anatomy laboratories [6].

All wounds apart from the clean minor wounds should be considered tetanus prone and must follow tetanus prophylaxis [14]. Level two laboratory safety guidelines recommend immediate washing of the injured areas with running water followed by covering of the region with a bandage or sticking plaster to avoid any direct contamination of the wound [15, 16]. In our study, of those who sustained cut injuries, 24 (77.3%) did not take the tetanus

vaccination. Furthermore, of those with skin contact with cadaver fluid, only 74 (43.5%) washed immediately, while 92 (54.1%) waited until the end of the dissection session to wash. Only two (18.2%) students washed their eyes soon after the eye splash of cadaver fluid occurred.

According to the World Health Organization safety protocols interaction with bodily fluids of another individual is considered a health risk [13]. If splashes occur, eyes should be washed with running water or 0.9% normal saline as soon as possible for at least 20 minutes while avoiding soap or any other irritant liquids [10, 11, 13]. This is the single most important step in preventing eye injuries and spread of infections [17]. In the present study, majority of the students neglected the duration of washing of the contaminated eye. Protective eyewear was used in most biosafety level laboratories which our laboratory did not follow [12]. Nevertheless, use of protective eyewear is not seen in dissection laboratories in Sri Lankan Universities. Although wearing gloves was a policy in the anatomy laboratory, everyone in the study populations has touched the cadavers at least once during their course without wearing gloves. Direct contact with cadaveric matter is strictly advised against in many biosafety level two protocols around the world due to presence of potentially infectious organisms on the cadavers [12, 16, 18]. Several students reported skin rashes and allergies. This could be due to the lack of protective wear preventing direct contact with the cadaveric matter. Educating the students about proper hand washing techniques would help minimize the incidence of fungal infections of the nails and skin rashes. Lab coats were recommended in guidelines when conducting procedures with a potential for splashes [13, 18]. Lab coats were not made mandatory for our students due to unavailability of air-conditioned dissection halls and the heat in the laboratory complex. However, during our study, majority of the participants were willing to wear lab coats during dissections.

According to our findings, the active involvement in cadaveric dissections was not a major determinant of the frequency of cut injuries or eye splashes. Therefore, everyone stepping into the dissection hall will be at risk of contact with occupational hazards and avoiding contact with cadavers alone will not prevent the students from getting exposed.

One student in our study was not aware of the location of the sharp object disposal bin. This highlights the need to orient the students about the proper disposal techniques and where the relevant stations or protective equipment are in the laboratory complex.

It is mandatory for the medical students to be aware of the potential hazards in anatomy laboratories and what measures need to be taken in the event of an exposure. Students should be informed and emphasized on the risks of occupational hazards in an anatomy laboratory and what protocols to follow in an event of exposure [1, 5, 18].

Strengths and limitations of the study

This was a single centre study. We only looked at the occupational hazards encountered by first year medical students in the anatomy laboratory. We used a questionnaire to collect data on students' practices rather than direct observations. Since we collected data at the end of the first year, there is a potential for recall bias. Thus, a combined quantitative and a qualitative approach at regular periods during their first year would have gathered robust data on students' exposures to occupational hazards and their post-exposure practices.

Conclusions

The study demonstrated that cut injuries, cadaver fluid contact with skin and eye splashes were commonly encountered during the first-year of dissections. Majority did not follow appropriate post-exposure precautions which could minimize subsequent health problems. Some of the protocols practiced worldwide in laboratories which handle human tissues such as using lab coats were not strictly practiced in our laboratory. Creating awareness about the safety protocols among students is vital to minimize exposure to occupational hazards. We recommend conducting audits among students, academic staff and academic support staff on a regular basis.

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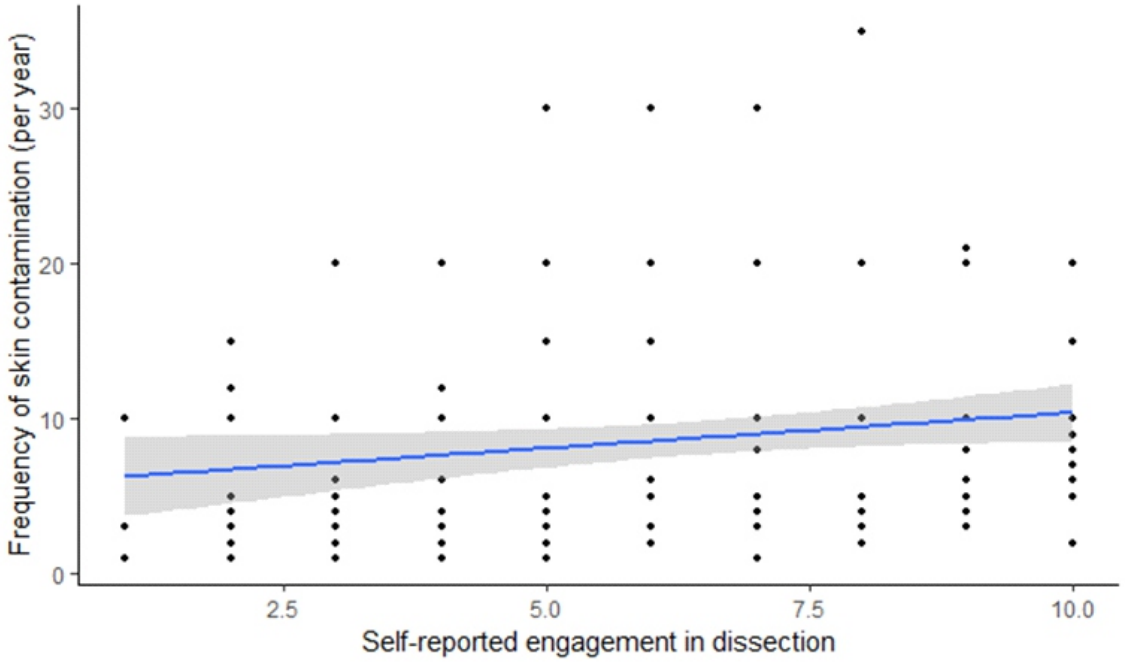
Figures

Figure 1: A scatterplot of showing correlations between frequency of skin contamination with cadaveric fluid (measured as the number of incidences per year) and the self-reported engagement in dissections (measured in a 10-point Likert scale; 1=never, 10=always). The shaded area represents the 95% confidence interval of the regression line.



CASE REPORTS

An unusual bifurcation of sciatic nerve deep to Piriformis: Case report with review of literature

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Introduction

Sciatic nerve, the thickest nerve in the body, is formed in the pelvis from the sacral plexus. It is comprised of both anterior and posterior divisions of fourth lumbar to third sacral spinal nerves [1]. Having left the pelvis through the greater sciatic foramen, it courses beneath the piriformis and enters the gluteal region. Then it travels over the gamelli, obturator internus and quadratus femoris and descends vertically midway between greater trochanter and ischial tuberosity [1].

During its course in the posterior compartment of the thigh, it divides into tibial and common peroneal nerves. This division is observed to occur usually a hands breath above the knee joint [1]. However, numerous variations have been reported with regard to its course and divisions. Clinical consequences such as entrapment syndromes and failure of regional nerve blocks are known to be associated with variant courses and divisions [2, 3]. Bilateral division of the sciatic nerve deep to the piriformis muscle and a variant course of its common peroneal branch seen on a cadaver is discussed.

Case presentation

Routine dissection was performed on a self-donated cadaver in the dissection laboratory of the Department of Anatomy, Faculty of Medicine, University of Colombo. The deceased was a 62-year-old man. The cadaver was preserved using Phenoxyethanol as the main preservative. An incision was made along the iliac crest and extended along the dorsal midline in the gluteal region. Piriformis was exposed by dividing gluteus maximus and gluteus medius. It was observed that the sciatic nerve was divided into tibial and common peroneal branches within the true pelvis bilaterally (Figure 1). Having coursed deep to the piriformis, both tibial and common peroneal nerves emerged into the gluteal region inferior to the lower border of piriformis. Piriformis was undivided. Both nerves crossed superior and inferior gamelli, obturator internus and quadratus femoris as they coursed towards posterior thigh. No associated anomalies were found on the cadaver on subsequent dissections.

Discussion

Sciatic nerve, the largest branch of the lumbosacral plexus demonstrates numerous variations in its anatomical course and has gained interest of many researchers. These dissimilarities in the course of nerve could occur with sciatic nerve dividing before or after exiting the pelvis (Table 1). In our cadaveric specimen we observed a division before the nerve exit the pelvis deep to the piriformis muscle. Sciatic nerve division commonly occurred after exiting the pelvis than within [4-7]. Guvencer et al., however observed in a 25 specimen study that the prevalence of intrapelvic and extrapelvic divisions of sciatic nerve was almost similar accounting for 48% and 52% respectively [8].

Furthermore, in our study we observed division of sciatic nerve into common peroneal and tibial branches. Although majority of the studies include bifurcation of the nerve similar to our findings, there were cases of trifurcations as well [4, 9, 10]. These reported trifurcations frequently were extrapelvic divisions [4, 9, 10]. In a study done by Anbumani et. al., four fifths of cadavers that had sciatic nerve variations were bilateral, while one fifth was unilateral [11]. In our dissection the variation was present bilaterally. In some instances the high divisions in sciatic nerve components rejoined in the mid-thigh [12] which was not observed in our case.

In its intrapelvic path sciatic nerve holds a neighboring relationship with piriformis. In 1937 Beaton and Anson's first described six ways of how the sciatic nerve can emerge in relation to piriformis muscle (Figure 2) [13]. These are: undivided nerve below undivided piriformis muscle (type A), division below and between the piriformis divisions (type B), divisions above and below the undivided piriformis (type C), undivided nerve between divided piriformis (type D), divisions above and between the piriformis divisions (type E) and undivided nerve above the undivided piriformis (type F) [13]. However, Beaton and Anson did not observe variation types E and F in their study.

Site at which the sciatic nerve divides near piriformis is surgically important when treating piriformis syndrome [2]. In majority of cases sciatic nerve followed a typical anatomical course or "a normal course" appearing undivided below undivided piriformis in 83.1% of individuals, while 16.9% had deviations from the said presentation [14]. Second commonest presentation was presence of one division through the piriformis and one component below the muscle [8, 13, 15]. Guvencer et, al., reported common peroneal nerve emerging above piriformis with tibial nerve emerging below piriformis in 8% out of 24% of high sciatic nerve divisions [8]. The various study findings in relation to Beaton and Anson classification is summarized in Table 2. According to these classifications, when there is a division of the sciatic nerve in the gluteal region, the common peroneal nerve usually pierces piriformis or emerges above the muscle to run superficial to the piriformis. Nevertheless, in our case we observed that both tibial and peroneal components divided deep to piriformis, and the common peroneal nerve continued to course deep to the muscle

accompanying the tibial nerve, to emerge below the lower border of the piriformis. To our knowledge this anatomical variation is a very rare presentation and is a deviation from the Beaton and Anson's classification.

Conclusion

Bilateral division of the sciatic nerve deep to the piriformis muscle is usually associated with the peroneal nerve coursing superficial to the muscle. However, a rare variant course of the common peroneal branch deep to the muscle in a case of a sciatic nerve division in the gluteal region is reported in this case.

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Tables

Table 1

Name of researchers	Level of division	
	Before exiting pelvis	After exiting pelvis
Lewis et al.,[16]	11.8% (12/102)	88.2% (90/102)
Guvencer et al[8]	48.0% (24/50)	52.0% (26/50)
Kotian et al.[17]	53.3% (32/60)	45.0% (27/60)
Pokomy D et al.[18]	20.9% (19/91)	79.1% (72/91)

Table 2: Anatomical variations associated with high division of sciatic nerve

Author and year / Types [13]	Beaton and Anson 1937 [13]	Samara et al 2016 [16]	Saritha et al 2012 [19]	Pokorny et al 2006 [18]
A – Undivided nerve below undivided piriformis	84.2%	89% (90/102)	88% (1329/1510)	79.1% (72/91)
B – Divided nerve below and between piriformis divisions	11.7%	8.8% (9/102)	11% (166/1510)	14.3% (13/91)
C – Divided nerve above and below undivided piriformis	3.3%	2.9% (3/102)	0.86% (13/1510)	4.4% (4/91)
D – Undivided nerve between divided piriformis	0.8%	0%	0.13% (2/1510)	2.2% (2/91)
E – Divided nerve above and between the piriformis divisions	0%	0%	0%	0%
F – Undivided nerve above the undivided piriformis	0%	0%	0%	0%

Figures

Figure 1: Cadaveric dissection showing the bifurcated sciatic nerve emerging below the piriformis.

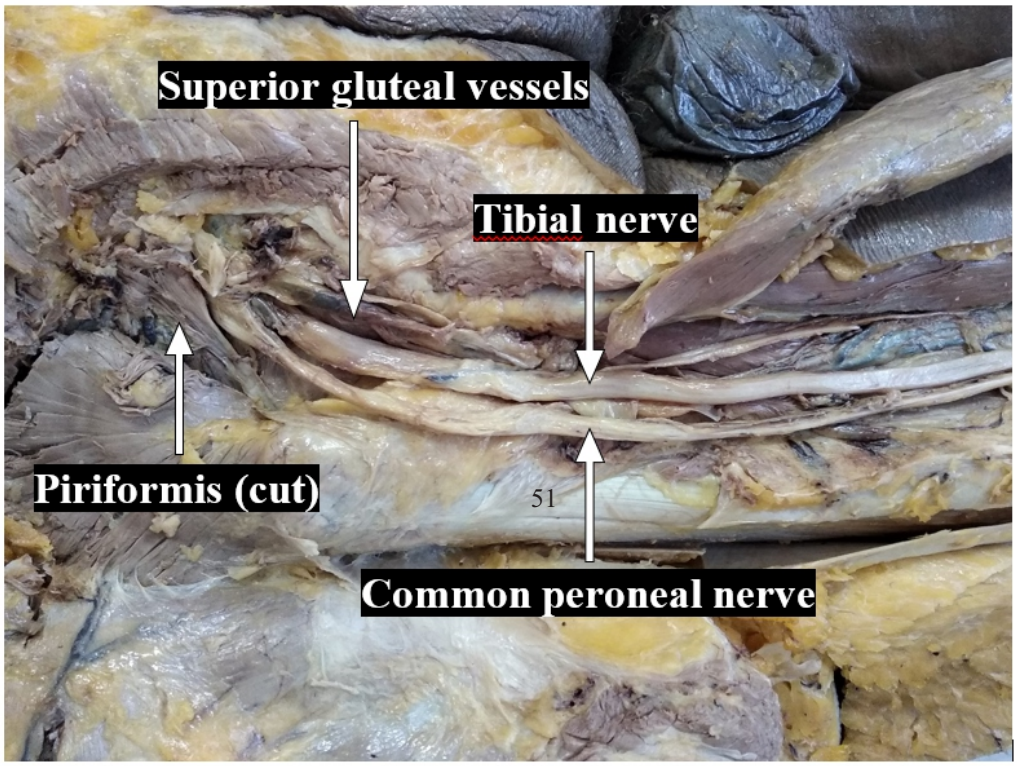
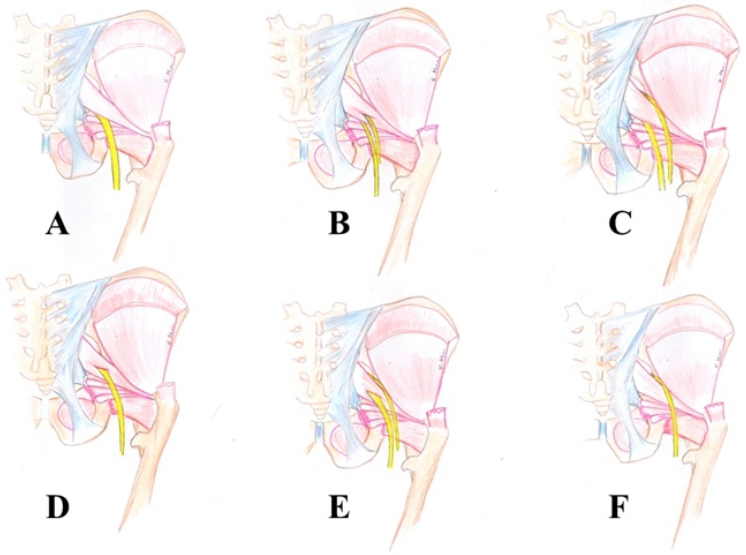


Figure 2: Anatomical variations of division and course of the sciatic nerve with relation to piriformis. This classification was originally described by Beaton and Anson [13].



Anatomy of thoracoscopic thymectomy; case report

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Abstract

Thymectomy is performed for myasthenia gravis with or without thymoma. Performing by thoracoscopy reduces the surgical morbidity. Anatomical landmarks play a key role to perform a safe surgery. We present the anatomical highlights of a patient who underwent the procedure

Introduction

Thymectomy improves mysthenia gravis(MG) and may induce remission or reduce the doses of pharmacological treatment(1). Traditional ways of doing Thymectomy are trans-sternal or trans-cervical. How ever if done by thoracoscopy, morbidity of open surgery will be reducced(2).

We discuss a patient who underwent Thoracoscopic Thymectomy for MG with a thymoma who was also dependent on steroids.

Case report

The patient being discussed is a 55 year old female diagnosed with MG. On cross sectional imaging he was found to have a thymoma. She required several ICU admisions to control myesthenic crisis. Further she was also dependent on steroids. (Figure 1)

Procedure

Patient positioning

After general anasthesia with endotracheal intubation patient was placed on supine position with abduction of right upper limb over the head to expose the axilla.

Ports placement

3 ports were inserted using following land marks in an inverted triangle in third, fifth and seventh intercostal spaces. (Figure 2)

Creating space for dissection

To obtain space for dissection, pneumothorax 8 mmHg was induced by insuflation of carbon dioxide.

Identifying and demostration of anatomical land marks

Following anatomical structures were identified; right brachiochephalic vein, it's union with left brachiochephalic vein, superior vena cava, phrenic nerve and internal mamary vessels which are running downwards over the right side of the pericardium. The magnified image allows clear identification of anatomy. Anatomical relations of above are as follows. (Figure 3, Figure 4)

Surgical dissection

After demostrating the anatomy clearly, dissection was started with incision of parital pleura over the superior and anterior mediastinum by using coagulation diathermy. Then proceeded with dissecting around the thymus with surrounding fatty tissue by using bipolar diathermy and ultrasonic dissector. Thymic vein was clipped and divided. Specimen was retrieved using a retrieval bag. 22G intercostal tube was inserted through one of 5mm port and kept it for 1 day.

Post operative

Patient was managed on the first day in the intensive care unit on spontaneous breathing. She had minimal analgesic requirements, oral feeding commenced on same day. She was discharged on the fifth post operative day.

Discussion

Traditional ways of doing Thymectomy are trans-sternal and trans-cervical approaches associated with a higher morbidity. In contrast in thoracoscopic approach, there is minimal incision, minimal pain, less wound related complications and early retern to normal activities. This was seen our patient.

In thoracoscopic thymectomy usually the access to the thymus(thymoma) is through right hemithorax. But in some cases where thymoma is more towards left side approach is through the left hemithorax. Here we approached through right hemithorax.

Standard way of getting space for Thoracotomy or Thoracoscopic procedure is single lung ventilation with the use of a double lumen endotracheal intubation and complete collapse of ipsilateral lung. However this needs more expertise and has some associated complications. The technique we use is with a single lumen tube ventilating both lungs and obtaining a partial lung collapse using a capnothorax. This is easy to perform, less complicated while providing adequate space for dissection.(3)

Clear identification and demostration of anatomical structures is necessary prior to initiation of dissection. Those structures are right brachiochephalic vein, it's union with left brachiochephalic vein, superior vena cava, phrenic nerve and internal mammary vessels which are running downwards over the right side of the pericardium. With thoracoscopy perception of Anatomy is easy due to magnified image and ability to zoom closer as demonstrated in this patient.

Conclusion

The patient presented illustrates that clear identification of anatomical land marks and a safe dissection is possible during thoracoscopic thymectomy and is associated with a lower morbidity.

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Figures

Figure 1

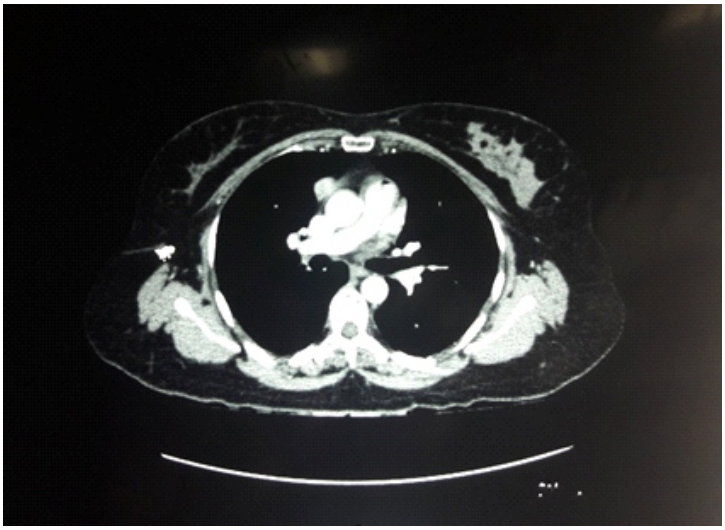


Figure 2

Figure 3

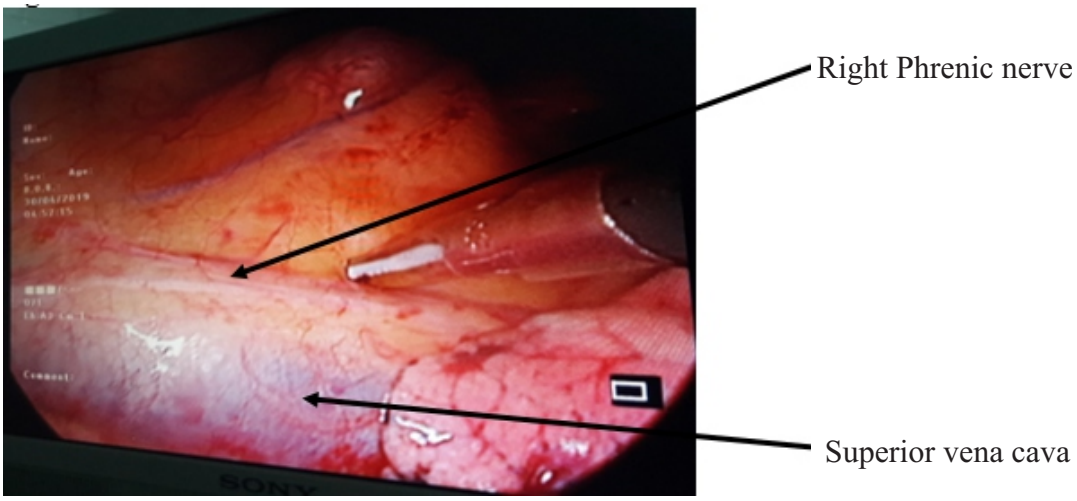
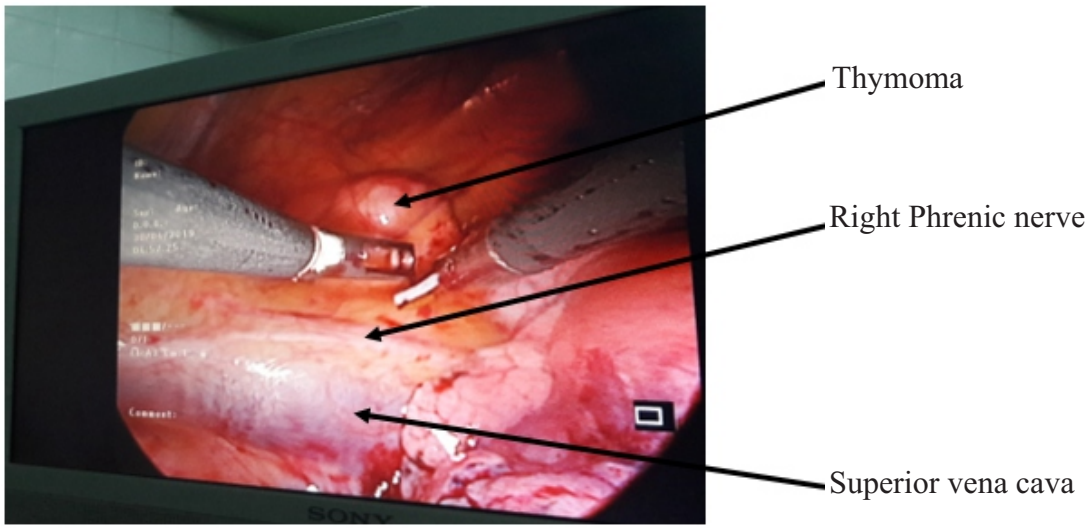


Figure 4



Thoracoscopic sympathectomy for chronic ischaemic pain in the upper extremity

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Keywords- Thoracoscopy, Sympathectomy, Buerger's, Limb Ischaemia, Peripheral vascular disease

Introduction

Thrombangitisobliterans (Buerger's disease) is a non-atherosclerotic inflammatory disease which affects small & medium sized vessels (1).The incidence of this condition variable in different countries from 5-50% of the diagnosed patients with PVD. Of these 1/4th is described to be involving the upper limbs. More often, Buerger's disease is not amenable to surgical revascularization and when advanced,leads to debilitating disease culminatingin multiple extremity gangrene and amputations. However sympathectomy has been reported to alleviate pain and help in superficial ulcer healing (2).

We present a patient with Buerger's disease who was successfully treated by thoracoscopicsympathectomy for ischaemic pain of left hand.

Case report

A forty four year old male with a history of 25 pack years of smoking presented with dry gangrene of 2 digits of left hand& debilitating rest pain. The onset of his symptoms was at the age of 34 years & he has undergone right side below knee amputation 5 years ago. His CT angiogram confirmed Buerger's disease not amenable to revascularization. Patient was advised on smoking cessation & pharmacological therapy was initiated but showed minimal response with regard to pain control after 6 months. Therefore thoracoscopicsympathectomy was discussed and consent obtained.

Patient was intubated with single lumenendotracheal tube and both lungs were ventilated. Patient was positioned in semi-prone position. Lung collapse was obtained with a capnothorax of 8mmHg. Three ports (Figure 1) were used.

Sympathectomy from 2nd to 4th Thoracic ganglia was performed using monopolar diathermy hook. There was no measurable blood loss and duration of procedure was 20minutes.Post-operative intercostal drainage was not used. The 2 gangrenous digits were amputated and wounds were kept open. They showed delayed but positive evidence of healing on follow-up

Patient was started on oral feeding and mobilized out of bed on same day. Objective pain assessment using visual analogue scale (VAS) showed a significant decline from 8/10 to 3/10.Patient was discharged on D2 of surgery. Patient's pain remained at 3/10 on VAS at 6 weeks review (Figure 2).

Discussion

Afferent pain impulses from the extremities reach the CNS via both dorsal root ganglion and sympathetic fibres. Of these general visceral afferent fibres associated with transmission of ischaemic pain predominately follow sympathetic pathwaysthrough sympathetic ganglia and reach dorsal root ganglia via white rami communicans (3). Thus disruption of sympathetic chain causes immediate pain relief (4). Also sympathetic efferents innervate dermal capillary bed which once disrupted causes capillary dilatation leading to increased dermal blood flow which intern is believed to aid in wound healing (5).

Conclusions

Thoracoscopic techniques are preferable due to the improved visualization, markedly less surgical morbidity as well as faster recovery (6).

Thoracic sympathectomy is effective to relief ischaemic pain in Buergers disease. It can be effectively performed by thoracoscopy which allows early discharge from hospital.

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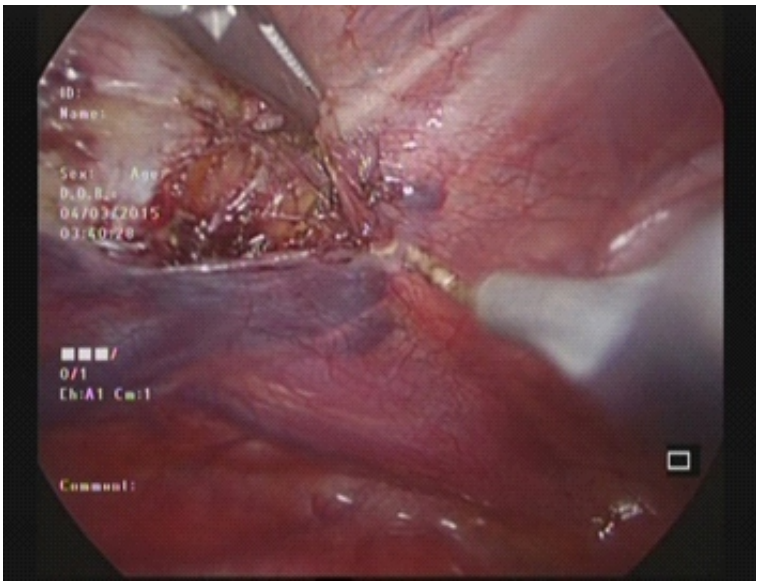
Figures

Figure 1. Patient positioning and port placement for thoracoscopicsympathectomy

Figure 2. Thoracoscopicsympathectomy with monopolar hook



Case report; An adult presenting with bilateral hip joint dysplasia

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Introduction

Developmental dysplasia of the hip (DDH) describes a spectrum of conditions associated with the development of the hip in infants and young children. The spectrum includes abnormalities of stability (dislocation, subluxation) and abnormalities of shape of the femoral head and acetabulum (dysplasia). Dislocation and subluxation means complete loss of contact between the acetabulum and femoral head and partial loss while maintaining the contact between them respectively. Dysplasia encompasses various abnormalities of the shape of the hip joint usually shallow acetabulum. Normally DDH is diagnosed during infancy or early childhood following routine screening procedures or following consultations. Dysplasia without dislocation usually has no clinical findings and can be asymptomatic until adulthood. It is often found incidentally when radiographs are obtained for other concerns or when an adult presents with hip joint pain or abnormal gait. We are reporting a case of female patient diagnosed with dysplasia of the hip in her early thirties.

Case report

Mrs.B, 34 year old female presented to the Rheumatology unit at DGH-Hambantota with bilateral hip joint pain for one year duration. She was a housewife with a child of 3 year old. She described the pain as insidious in onset and progressive in nature mainly with weight bearing. Also pain was deep aching type in nature. Pain exacerbated with activities like walking and climbing a staircase and relived with rest. She did not give history of any traumatic event. She had memory of a similar episode of hip joint pain about 15 years ago which had lasted about 2 to 3 months but she could not recall any more details or did not have any documented evidence about investigations or treatment. During this presentation she did not have any other joint pain or swelling; no fever; no other specific complaints. She denied past medical or surgical problems and had normal uncomplicated vaginal delivery 3 years back. On examination she had normal gait with a mild limp. Left hip joint examination revealed restriction of all movements (flexion-40, abduction-30, adduction-20, internal rotation-20, external rotaion-30 degrees). Right side hip joint demonstrated reduced but to a lesser extent ompared to the left. (flexion-70, abduction-40, adduction-30, internal rotation-40, external rotation-40 degrees). There was no discrepancy in length of the leg. She did not have any other tender or swollen joints and all the other joint movements were in normal range. Subsequently she underwent few investigations which revealed no abnormality including

normal inflammatory markers, negative rheumatoid factor, normal calcium level and thyroid functions. Then we arranged x rays of hip joints which are shown in picture 1,2 and 3. Finally it was diagnosed as bilateral acetabular dysplasia most probably developmental in origin with late presentation. Then we discussed with her and explain the nature of the condition and referred to the orthopedic unit for possible surgical correction.

Discussion

The hip joint is a ball and socket type synovial joint which facilitates wide range of movements without compromising stability. It is formed by the articulation of the femoral head with the acetabulum of the pelvis. All three constituents of the pelvic bone participate in forming the acetabulum; namely ileum forms the superior part, pubis forms the anterior and ischium forms the posteroinferior part. During foetal development by the 11th week of gestation, the hip joint fully develops and the spherical femoral head deeply lie within the acetabulum. However, as the femoral head grows faster than the acetabulum, at the end of the gestation femoral head is incompletely covered by the acetabulum. Also during newborn period ligamentous laxity makes the developing hip susceptible to other external mechanical forces. These factors result in abnormal contact between the femoral head and the acetabulum. If this is not corrected abnormal hip joint contact can lead to structural anatomical changes like everted and flattened labrum, shallow acetabulum, abnormal ossification of the acetabulum [4] and inhibit the normal hip joint development. This can lead to various dysplastic changes of the hip joint with or without dislocation. This is known as Developmental Dysplasia of the Hip (DDH) which can range from symptomatic dislocation and instability to asymptomatic dysplsia. It is calculated that DDH has prevalence of 3 to 5 per 1000 children [1]. And it is more common among infants with certain risk factors (eg, female sex, breech position) [2].

The range of presentation of DDH can vary widely from instability during the newborn examination to subtle limited abduction in the infant, to asymmetric gait in the toddlers. When DDH is not detected and corrected early, patients may present with activity associated hip joint pain or hip joint osteoarthritis in the adulthood. Hip joint dysplasia without dislocation usually has no clinical findings and it could remain asymptomatic until early adulthood, which is the case with this patients. It is often found only through screening of risk factors or incidentally when radiographs are obtained for other concerns especially when investigating for activity related hip pain in an adolescent or young adult. Clinical course for patients with this presentation is variable but eventually it can lead to premature degenerative joint disease in hip joints. Pain may start soon after skeletal maturity or in females, during the pregnancy. Patients 40 to 60 years old who present with hip osteoarthritis are often found to have mild dysplasia as a contributing cause [3,4].

So it is important to identify every form of DDH as soon as possible to initiate early corrective measures in order to prevent permanent abnormalities and deformities. Every infant soon after the birth should undergo thorough clinical examinations of the hip joints to identify any dislocatability. Any infant with suspicion should be directed to further investigations. Ultrasonography is the primary imaging technique for assessing the morphology and stability of the infant hip. Place of X rays of the hip joints in evaluating DDH depends upon the age of the patient and the degree of ossification. Plain radiographs have limited value in the detection of DDH during the first six months of life when the femoral head and acetabulum are unossified. Children after the age of six months and in adults plain radiographs are useful in the evaluation for DDH [5].Lateral and superior positioning of the ossified portion of the femoral head and neck is an important finding consistent with DDH.

Once diagnosed treatment of DDH is initiated with referral to a orthopedic surgeon. The goals of treatment are to obtain and maintain concentric reduction of the hip to provide an optimal environment for the development of the femoral head and acetabulum. Treatment option depends on the age at which DDH is diagnosed. Infants younger than six months who have dislocated or persistently have the potential to dislocate hips are usually treated with abduction splinting. Children older than this require closed or open reduction under anesthesia. Undiagnosed dysplasia may result in progression to premature degenerative joint disease ultimately requiring surgical interventions including hip joint replacement during adulthood.

This case emphasizes the importance of neonatal clinical assessment of the hip joints especially those with risk factors for DDH.

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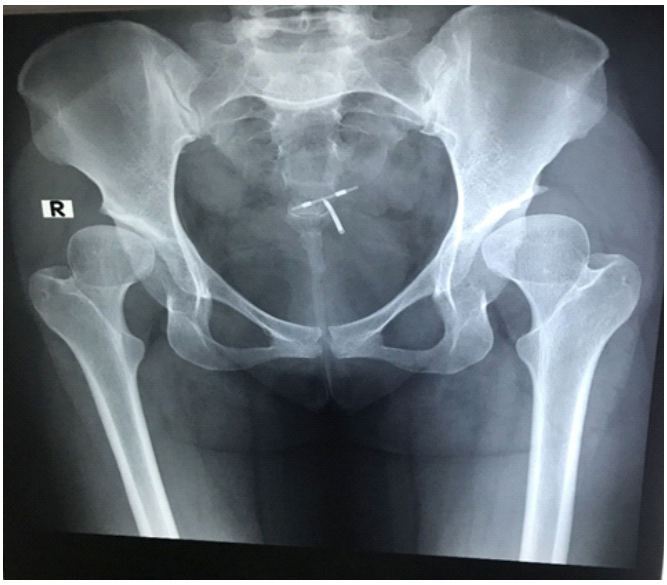
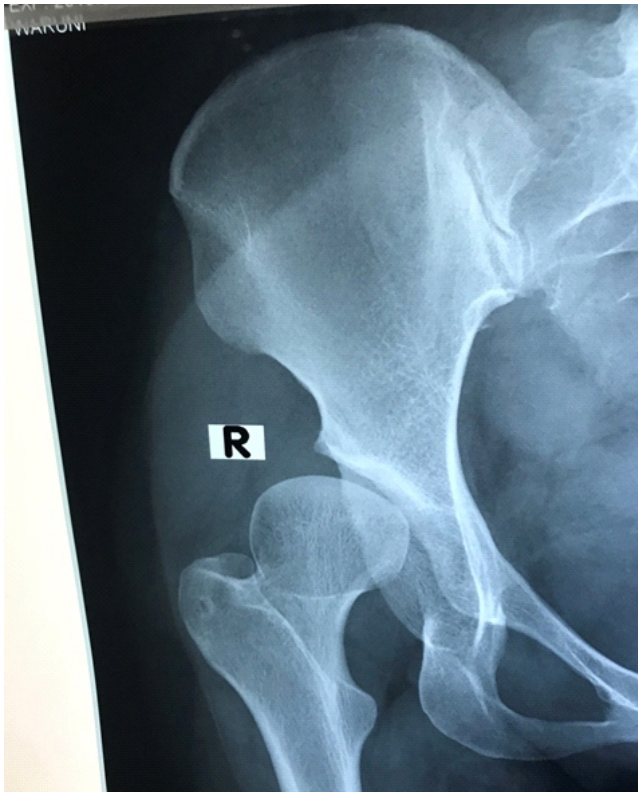
Figures

Figure 1. X ray Pelvis including bilateral hip joints



Picture – 2 – X ray view of left hip joint

Picture 3 – X ray view of right hip joint



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All graphs, drawings, and photographs are considered figures and should be numbered in the order of appearance in Arabic numerals. Each figure should have a brief and specific legend, and all legends should be typed together on a separate sheet of paper. Photographs should be glossy prints and the reverse should give the figure number, title of paper, principal author's name and have a mark indicating the top. Colour illustrations may be submitted in instances where their use may contribute significantly to the scientific value of the article. Colour illustrations may be printed free of charge at the Editor's discretion, whereas others may be printed at the author's expense.

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Journals

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Bartlett IG, O'Keefe P. The bacteriology of the perimandibular space infections. JOral Surg 1979; 37: 407-409. 64

Corporate (collective) author

WHO COLLABORATING CENTRE FOR ORAL PRECANCEROUS LESIONS. Definition of Leukoplakia and related lesions: an aid to studies on oral pre cancer. Oral Surg Oral Med Oral Pathol 1978; 46: 518-539.

Unpublished article Barker DS. Lucas RB. Localized fibrous growth of the oral mucosa. J Dent ?Res 1965: in press.

Books and other monographs Pindborg JJ. Atlas of diseases of oral mucosa. 5th edition. Copenhagen: Munksguard, 1992: 50-66.

Chapter in book Boyde A. Amelogenesis and the structure of enamel. In: Cohen B. Kramer KH(eds). Scientific Foundations of Dentistry. William Heinemann Medical Books Ltd. London. 1976: 335-352.

No author given International statistical classification of diseases and related health problems, 10th revision, vol 1. Geneva: World Health Organization, 1992; 550-564.