Not written on the records: a rare case of ipsilateral disappearance of the femoral head and neck and other bone abnormalities on a female skeleton from the Luís Lopes Collection (Lisbon, Portugal)

Não escrito nos registos: um caso raro de desaparecimento ipsilateral da cabeça e colo do fémur e outras anomalias ósseas num esqueleto feminino da Coleção Luís Lopes (Lisboa, Portugal)

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Abstract This article aims to describe a paleopathological case consistent with a paediatric hip joint trauma, discussing its aetiologies and lifelong implications, such as limb asymmetry and osteoarthritis. The case studied is a well-preserved skeleton of a female individual (Museu Nacional de História Natural e da Ciência, Universidade de Lisboa) who died in Lisbon in 1954, at the age of 54. The bone changes were macroscopic and radiologically studied, complemented by a differential diagnosis. The study revealed ante mortem absence of the left femur head and neck, marked shortening and narrowing of the left os coxae, and alterations in the acetabulum.

Resumo Este artigo tem como objetivo descrever um caso paleopatológico consistente com um traumatismo da anca em idade pediátrica, discutindo as suas etiologias e implicações a longo prazo para a vida do indivíduo. O caso estudado é um esqueleto bem preservado de um indivíduo do sexo feminino (Museu Nacional de História Natural e da Ciência, Universidade de Lisboa) que faleceu em Lisboa, em 1954, com 54 anos de idade. As alterações ósseas foram estudadas macroscópica e radiologicamente e complementadas com o diagnóstico diferencial. O estudo revelou ausência ante mortem da cabeça e do colo do fémur esquerdo, acentuado encurtamento e estreitamento do coxal

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Additionally, an atrophy of the left lower limb was observed, except for the metatarsals and toes, torsion of the right femoral neck, and severe right knee osteoarthritis. A traumatic fracture affecting the acetabulum and the proximal femur during the developmental stage of the individual's life may account for the spectrum of changes observed in the post-cranial skeleton, albeit other conditions, such as septic arthritis of the hip, were also considered in the differential diagnosis. These fractures likely disrupted the blood supply, leading to necrosis and subsequent resorption of the femoral head, associated with adjustments in the shape of the acetabulum and atrophy of the lower limb. Trauma in a still immature skeleton can significantly impact the affected individual's life, as it may lead to pernicious secondary complications.

Keywords: Paleopathology; pelvic fracture; disuse atrophy; bone asymmetry; impairment.

esquerdo e alterações no acetábulo. Observou-se ainda atrofia por desuso do membro inferior esquerdo, com exceção dos metatársicos e falanges dos pés, torção do colo do fémur direito e osteoartrose severa no joelho direito. Uma fratura traumática que afetou o acetábulo e a extremidade proximal do fémur esquerdo durante a fase de desenvolvimento ósseo do indivíduo poderá explicar o espetro de alterações observadas no esqueleto pós-craniano, no entanto, outras condições, como artrite séptica da anca, foram também consideradas no diagnóstico diferencial. É provável que essas fraturas tenham interrompido o fornecimento de sangue, levando à necrose e subsequente reabsorção da cabeça femoral, associada a ajustes na forma do acetábulo e atrofia do membro inferior. Casos de trauma pediátrico podem impactar fortemente a vida do indivíduo afetado, já que podem gerar complicações perniciosas.

Palavras-chave: Paleopatologia; fratura da bacia; atrofia por desuso; assimetria óssea; invalidez.

Introduction

Differential diagnosis is a complex, yet crucial, step in understanding the nature and burden of disease in a skeletal population (Mays, 2018). Researchers employ several methods, with the comparative approach being the most common. Anatomical skeletal collections, such as the Lisbon Identified Skeletal Collection (aka Luís Lopes), have been widely used to develop and test hypotheses regarding the morphology of lesions and patterning of skeletal involvement and possible association with the cause-of-death of individuals (e.g., Matos and Santos, 2006; Marques et al., 2021). This collection is large, and skeletons are almost complete, including a high number of young individuals, and representing a wide diversity of bone manifestations of disease (individuals were not selected for conspicuous lesions). Moreover, for nearly 800 individuals, the collection has data on the cause of death, and the great majority of adults were assembled before modern therapies were available to the population. However, like other reference collections, it also presents limitations that may bias the application of the comparative methods and the interpretation of results. It lacks a complete clinical historiography of individuals. Although the information on the cause of death is known, the cause of the lesions is not. Moreover, it does not inform whether other non-lethal conditions coexisted at the time of the death or if diseases distinct from the cause of death affected the individuals and ultimately the skeleton (Brickley and Ives, 2008; Mays, 2018). Accordingly, the study of pathological cases derived from modern reference collections is not as straightforward and poses challenges, like those encountered in the study of archaeological human remains. The present case study exemplifies the abovementioned limitations. It describes a case of conspicuous lower limb asymmetry (not listed in the death certificate) resulting from an ipsilateral femoral head and neck ante mortem disappearance on an adult female skeleton from the Luís Lopes Collection — Museu Nacional de História Natural e da Ciência, Universidade de Lisboa (NMNHC) who died of psychotic schizophrenia. Further goals include the description and interpretation of additional upper limb asymmetries and craniocervical anomalies and their possible relationship with the cause-of-death. Ultimately, it aims to discuss the impact of joint disease on a developing skeleton and the ways the bone tissue has adjusted to and recovered from the injury.

Lower limb asymmetry and its multiple aetiologies

Lower limb asymmetry (LLA), also termed leg length inequality (or discrepancy/disparity), is defined as the difference in lengths of paired limb extremities (Brady et al., 2003; Golightly et al., 2007). LLA can be classified as anatomical when the discrepancy is caused by shortening or lengthening of a bone or a group of bones, or functional, when no physical shortening of the bones of the lower limb exists, which might occur following joint contractures or foot mechanics dysfunctions (Morscher, 1977; McCaw and Bates, 1991; Brady et al., 2003). Anatomical LLA may have a congenital aetiology related to structural and non-structural defects (e.g., aplasia, hypoplasia, or proximal focal femoral deficiency, hip dislocation, Klippel-Trenaunay-Weber Syndrome, and neurofibromatosis) or an acquired origin (Lessa, 2011; Sánchez et al., 2013). Some commonly acquired aetiologies include infection, particularly septic arthritis of the hip (Zhan et al., 2023), and trauma, such as epiphyseal growth plate (or physis) injury and diaphyseal fractures with marked overriding of bone fragments (Morscher, 1977; Brady et al., 2003; Sánchez et al., 2013).

Septic arthritis is a bacterial, viral, or fungal infection of the synovium and adjacent tissues that often affects the large joints of the lower limb (i.e, hip, knee, and ankle) (Burt et al., 2013; Rutz and Spoerri, 2013; Pääkkönen, 2017). Most cases develop by haematogenous spread of bacteria, particularly *Staphylococcus aureus* and respiratory pathogens. Other routes include local dissemination from an osteomyelitis focus or direct inoculation from penetrating injury (Rutz and Spoerri, 2013; Nannini et al., 2023). Bacterial septic arthritis of the hip is more frequent in children of the male sex and can severely damage the hip joint, femoral head and neck or growth plaque, resulting in an apparent leg length discrepancy due to malposition of the limb (Cheng and Lam, 1996; Spiegel et al., 2007). Septic arthritis of the paediatric hip joint is an uncommon condition (Nannini et al., 2023), and its diagnosis in archaeology can be difficult because there is no feature unique to the condition (Buikstra, 2019). Bone trauma involving the epiphyseal growth plates accounts for 18%-30% of paediatric fractures. It primarily affects the distal femoral and tibial physis and may cause arrested growth, often leading to lower limb asymmetry and bone deformities in adults (Shaw et al., 2018).

Material and methods

The skeleton (MB61:00562) under analysis belongs to a female individual aged 54, who died in the city of Lisbon, in 1954, with psychotic schizophrenia listed as the cause of death. There is no medical history of the individual beyond the cause of death. The skeleton is well-preserved and almost complete (Table 1). The skeleton was examined macroscopically, and the hip and lower long bones were radiographed. The metric analysis was performed mainly on the long bones, with an osteometric board, a digital calliper, and a tape measure following Bass (1995) and Buikstra and Ubelaker (1994). All procedures were concluded with the differential diagnosis, and the Istanbul terminology framework was used (Appleby et al., 2015).

Description of the lesions

Exuberant bone changes were noticed in the left acetabulum and proximal femur. The left acetabulum showed an atypical configuration characterized by a shallow and discontinuous cavity, encircled by an irregular, thick rim of bone (Figure 1). The space of the ossification centres of the innominate is still visible. Scattered foci of bone porosity and hypertrophic bone formation are also discernible. No clear acetabular fossa and lunate surface were identified. An irregular patch of newly formed bone was identified at the attachment site of the iliacus muscle in the iliac fossa, accompanied by torsion of the pubic ramus towards the central axis (Figure 2). A close inspection of the left femur revealed the absence of the head and neck with complete obliteration of the proximal region (Figure 3), which exhibited small areas of porous bone and eburnation and new bone formations, like osteophytes. A mediolateral constriction and an anterior-posterior bowing were observed on the femoral shaft. An abnormally increased angle of inclination was observed in the neck of the right femur.

The macroscopic analysis of the female skeleton revealed pelvic and limb asymmetries (Tables 1 and 2). Marked

Table 1. Characterization of the biological and paleopathological profile of the MB61-00562 female skeleton.

Biographic data	Collection ID: MB61-00562, Luís Lopes Collection, Museu Nacional de História Natural e da Ciência (NMNHC), Universidade de Lisboa. Biological profile: Female, 54-year-old at the time of death. Birthplace and date: Lisbon, year of 1899. Place of death and date: Lisbon, year 1954. Occupation: "doméstica", which can mean either a housekeeper or housewife. Cause of death: Psychotic schizophrenia.
Bone preservation	The skeleton is well-preserved and almost complete. Only the hyoid, the left fibula, and some bones of the hand and feet are missing. Some teeth were lost post mortem (right central incisor and left lateral incisor).
Skull bones and ribs	Congenital defects on the base of the cranium and the cervical vertebrae. Ante mortem trauma on the nasal bones (healed) and on three rib shafts (unhealed): presence of thin layers of new bone near the edges of the broken bones.
Upper limb bones	Limb discrepancies in terms of length, breadth, and bone shaft circumference — e.g., clavicle (right shorter than the left one), radius and ulna (left shorter than the right one) (Table 2, supplementary material). Entheseal changes: right humerus (i.e., latissimus dorsi, pectoralis major, and teres major); right and left humerus (i.e., common extensor origin), right and left radius (i.e., biceps brachii) and ulna (i.e., triceps brachii).
Lower limb bones	Limb discrepancies in all bone dimensions — i.e., femur, tibia, patella, and foot bones (calcaneus, talus, and navicular). Right bones are larger — e.g., the left calcaneus is 3.6 mm shorter, and the talus is 2.6 mm. The metatarsals show symmetrical length and width. An osteophyte exists on the lateral head of the first metatarsals, more prominent on the left side (Table 2, supplementary material). Marked shortening and narrowing of the left *os coxae*. Shallow acetabulum with no clear acetabular fossa and lunate surface. Absence of the left femoral head and neck and anterior-posterior bowing of the left and right femur shaft. Joint changes: right knee joint (severe osteoarthritic changes — i.e., marginal and surface osteophyte formation, porosity, eburnation, and changes in the joints contour on the femur, tibia, and patella), left hip (with eburnation), right hip (without eburnation), second cuneiform, right calcaneus, talus and navicular (deformation and osteophytes), two middle and distal feet phalanges (fusion and marginal lipping at the proximal end). Entheseal changes: psoas major and iliacus, gluteus medius and maximum and soleal line, but more prominent in the great trochanter of the right femur.

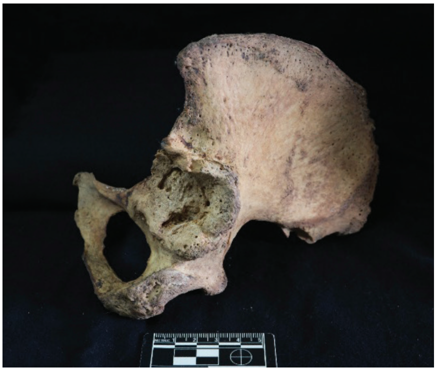

Figure 1. Lateral view of the left hip bone, with a shallow, irregular, and discontinuous acetabulum, MNHNC:MB61:00562, Luís Lopes Collection, Universidade de Lisboa (image: M. Amendola, Universidade de Lisboa).

Figure 2. Medial view of the left hip bone, with an irregular patch of newly formed bone at the attachment site of the iliacus muscle, MNHNC:MB61:00562, Luís Lopes Collection, Universidade de Lisboa (image: M. Amendola, Universidade de Lisboa).

Figure 3. Anteroposterior radiograph of the left femur showing ante mortem absence of the femoral head and bone densification on the proximal extremity MNHNC:MB61:00562, Luís Lopes Collection, Universidade de Lisboa (image: FMV, Universidade de Lisboa).

asymmetries in height and width were visible in the *os coxae*, with the left being shorter than its contralateral (172 mm compared to 192 mm). Diaphyseal and condylar breadth differences were observed in the femur and tibia: the right-side bones' diaphyses and epiphyses are larger in all dimensions (Figures 4 and 5). For instance, the right bone midshaft circumference is 74 mm and the left is 65 mm, the right circumference below the trochanter is 87 mm and the left is 70 mm. Similar asymmetries were observed on the patellae and tarsal bones, but the metatarsals and phalanges are symmetrical. Minor limb discrepancies were noticed in the upper limb bones, although the left-side bones were, in general, shorter, narrower, and with less pronounced muscle attachments when compared with the ones on the right side. The only exception was found for the clavicle, where the right is shorter, but the sternal extremity is much larger. The sternoclavicular joints are asymmetrical in size and form.

In addition to limb discrepancies, pronounced osteoarthritic changes were evident in the right knee, characterized by exuberant osteophyte formation and articular deformation (Figure 5). Osteoarthritis is also present in the right tarsal bones, more severe in the talonavicular articulation. No signs of osteoarthritis were observed on the left knee or tarsal bones. However, joint changes (porosity and/or lipping on the articulation margin) were observed on both shoulders

Figures 4 and 5. Anterior and posterior aspects of the femurs. The right femur displays a short, valgus neck, anterior-posterior bowing, and degenerative alterations on the distal extremity; while on the left there is atrophy along the shaft and on the distal articulation, MNHNC:MB61:00562, Luís Lopes Collection, Universidade de Lisboa (image: M. Amendola, Universidade de Lisboa).

Table 2. Measurements on the post cranial skeleton according to the standards in Buikstra and Ubelaker (1994) and Bass (1995).

Bone	Measurement	Right (mm)	Left (mm)	%	Asymmetry
Clavicle	Length	131.00	141.00	92.91	-7.35
	Circumference at midshaft	35.00	36.00	97.22	-2.82
	Sagittal diameter at midshaft	10.50	11.70	89.74	-10.81
	Vertical diameter at midshaft	9.00	10.60	84.91	-16.33
	Maximum diameter at the sternal end	27.00	22.20	121.62	19.51
	Maximum diameter at the acromial end	21.20	25.00	84.80	-16.45
Scapula	Height	144.00	150.00	96.00	-4.08
	Breadth	101.00	103.00	98.06	-1.96
	Glenoid cavity height*	35.40	33.80	104.73	4.62
	Glenoid cavity breadth*	26.30	25.40	103.54	3.48
Humerus	Maximum length	279.00	279.00	100.00	0.00
	Epicondylar breadth	52.30	52.60	99.43	-0.57
	Vertical diameter of head	42.00	40.20	104.48	4.38
	Maximum diameter at midshaft	25.50	24.00	106.25	6.06
	Minimum diameter at midshaft	15.10	14.50	104.14	4.05
	Midshaft circumference	69.00	66.00	104.55	4.44
	Least circumference of the shaft*	61.00	60.00	101.67	1.65
Radius	Maximum length	201.00	194.00	103.61	3.54
	Anterior-posterior diameter at midshaft	10.90	10.40	104.81	4.69
	Medial-lateral diameter at midshaft	13.90	13.70	101.46	1.45
	Head maximum diameter*	18.80	18.60	101.08	1.07
	Maximum distal epiphyseal breadth*	29.70	28.20	105.32	5.18
Ulna	Maximum length	224.00	216.00	103.70	3.64
	Minimum circumference	38.00	39.00	97.44	-2.60
Os coxae	Height	192.00	172.00	111.63	10.99
	Iliac breadth	151.00	145.00	104.14	4.05
	Pubis length**	68.70	77.00	89.22	-11.39
	Ischium length**	70.50	68.60	102.77	2.73
	Acetabulum: maximum height*,**	49.30	36.00	136.94	31.18
	Acetabulum: maximum width*,**	45.90	42.40	108.25	7.93
	Width of sciatic notch	46.90	40.40	116.09	14.89

Bone	Measurement	Right (mm)	Left (mm)	%	Asymmetry
Sacrum	Height of auricular surface	51.00	48.80	104.51	4.41
	Width of auricular surface	17.30	17.00	101.76	1.75
Patella	Maximum height	34.00	32.40	104.94	4.82
	Maximum width	40.50	33.80	119.82	18.03
Femur	Length at the greater trochanter*,**	360.00	352.00	102.27	2.25
	Epicondylar breadth	68.00	62.00	109.68	9.23
	Head vertical diameter	40.60			
	Antero-posterior subtrochanteric diameter	23.40	22.10	105.88	5.71
	Medial-lateral subtrochanteric diameter	26.70	21.10	126.54	23.43
	Midshaft circumference	74.00	65.00	113.85	12.95
	Circumference below the trochanter	87.00	70.00	124.29	21.66
Tibia	Length	319.00	317.00	100.63	0.63
	Maximum proximal epiphyseal breadth**	78.00	57.70	135.18	29.92
	Maximum distal epiphyseal breadth	46.80	40.20	116.42	15.17
	Maximum diameter at the nutrient foramen	25.30	24.00	97.31	-2.73
	Medial-lateral diameter at the nutrient foramen	23.30	17.00	132.39	27.87
	Circumference at the nutrient foramen	75.00	67.00	111.94	11.27
Fibula	Maximum length	305.00			
Calcaneus	Maximum length	66.9	63.3	105.69	5.53
	Middle breadth	35.7	31.6	112.97	12.18
Talus	Maximum length	52.3	49.7	105.23	5.10
	Width of the talus	36.8	35.0	105.14	5.01
Metatarsals	MT1 length*	58.30	58.1	100.34	0.34
	MT1 base D-P width	25.20	24.50	102.86	2.82
	MT1 base L-M width	18.60	16.30	114.11	13.18
	MT2 length*	69.0	70.7	97.60	-2.43
	MT3 length*	64.99	65.34	99.46	-0.54
	MT4 length*	62.49	60.93	102.56	2.53
	MT5 length*	58.05	58.21	99.73	-0.28

Asymmetry is calculated as: $|((Rt-Lt)/((Rt+Lt)/2))x100|$. A positive value indicates a larger right dimension. *Bass (1995); **Approximate measurement.

and elbows, as well as in some rib heads and tubercles. Signs of degenerative disc disease, such as pitting on the inferior and/or superior surfaces of the vertebral bodies, marginal osteophytes, and anterior body compression (e.g., T3, T5 and T7) were observed along the spine. Abnormal flattening of several spinous processes, particularly those of C7, T10-T12 and L2-L4, accompanied by right lateral bending of the lumbar segment, was also noticed. The right calcaneus, in the dorsal area, shows remodelled lamellar bone. There is a lateral extension of the distal articulation of the left first metatarsal. Furthermore, evidence of ante mortem trauma was observed on the nasal bones as well as on three rib shafts: one left rib and two right ribs. Of the right ribs, both display multiple fractures, and one of these right ribs exhibits two unhealed fractures, with layers of newly formed bone near the fractured edges.

Bone variations were observed in several bones of the axial skeleton: three were observed at the craniocervical joint, namely a bilateral precondylar tubercles with a depression and an incomplete bone bridging on the occipital bone, and a unilateral left retrotransverse foramen on the atlas. Moreover, the spinous process of the S1 is bifid, the twelfth left rib is rudimentary (the right one is not present), and there are also some alterations on the skull, for instance, the sutures are completely open, and the frontal grooves are unusually marked on the right side. On the feet, a bilateral partial coalition of the third metatarsal and the third cuneiform, and pedal symphalangism in two toes were identified (Mann et al., 2016).

Discussion

The marked asymmetry and acetabular changes of the left *os coxae* seem consistent with a paediatric pelvic fracture with premature closure of the triradiate (epiphyses) cartilage (TC).

In the present case, it is possible that the injury occurred before the complete formation of the acetabulum and epiphyseal union (11-16 years of age), eventually associated with a crushing fracture (see: Scuderi and Bronson, 1987; Heeg et al., 1988; Vassalou et al., 2018). The bone changes observed on the left proximal femur are consistent with a diagnosis of femoral neck fracture, possibly of type III: cervicotrochanteric (or basicervical), according to Delbet classification (see: Dial and Lark, 2018; Palocaren, 2018).

A displaced femoral neck fracture is a rare clinical condition in children (Song et al., 2013), with long-term morbidity, and a potential cause of life-long disabilities (Mirdad, 2002; Neri and Lancellotti, 2004; Lovell, 2016). Complications include avascular necrosis (AVN) (Mirdad, 2002), nonunion, varus malunion of the hip, and premature osteoarthritis (Bucholz and Rathjen, 1985; Curate et al., 2011; Palmu et al., 2013). In the case of basicervical fractures, they account for approximately 35% of paediatric hip fractures and carry a 20% risk of developing avascular necrosis of the femoral head (Dial and Lark, 2018). Fracture type and age are the most significant predictors of AVN. In children, the risk increases with age (Moon and Mehlman, 2006). As the proximal extremity of the femur articulates smoothly with the acetabulum, the femoral head was not present ante mortem. Post-traumatic resorption of the femoral head occurred and impacted the development of the left hip joint, as it is necessary for normal acetabular development, namely for its characteristic concavity or cuplike shape (Scuderi and Bronson, 1987; Heeg et al., 1988; Scheinfeld et al., 2015).

Both the acetabulum and femur injuries may be related. The rarity of the lesions, their skeletal position (a single blow, for instance, would affect both bones at once), and their remodelled state are highly consistent with a common origin. It is pertinent to mention that TC fractures often occur in association with concomitant pelvic ring injuries, proximal femoral fractures or femoral shaft fractures, post-traumatic acetabular dysplasia, femoral head subluxation and/or necrosis, and osteoarthritis (Badina et al., 2013; Gänsslen et al., 2013; Vassalou et al., 2018). Other severe complications include hip pain, pelvic tilt and asymmetry, and lower limb shortening, the latter condition conducive to altered gait and claudication (Galos and Doering, 2020; Dong et al., 2021). The lesion in the iliac muscle is typical of heterotopic ossification (HO), whose most common aetiology is soft tissue trauma (acute or multiple minor injuries) followed by ossification produced by damage to the muscle or periosteum (Waldron, 2009). HO is more commonly seen on the long bones (Assis and Garcia, 2023).

As mentioned, the bilateral asymmetry observed, for instance, in the size of the femoral condyles seems to support a common origin of both femoral and acetabulum lesions and an early in life occurrence. Knüsel (2000) mentions that a limb disability in a growing individual will affect both diaphyseal and articular dimensions, whereas disabilities occurring in mature individuals will be reflected in diaphyseal measurements only. Femur length is not substantially asymmetrical; thus, one may assume that the proximal epiphysis of the femur was closed or closing, which in females occurs between 14-16 years old (Cunningham et al., 2016).

In addition to trauma, other conditions (e.g., tuberculosis, syphilis, cancer metastasis, sickle cell disease, poliomyelitis, and congenital hip dysplasia — see Table 3) were considered and ruled out from the differential diagnosis.

However, septic arthritis of the hip bone produces intense inflammatory reactions that can result in severe complications, including osteomyelitis and joint ankylosis, which were not observed, and in the worst outcomes, systemic sepsis. Even so, the fact that it may be accompanied by osteonecrosis and complete loss of the femoral head and neck, as well as LLA, makes it impossible to completely rule it out of the differential diagnosis. Zhan et al. (2023) published a case of septic arthritis of the hip with some features

Table 3. Differential diagnosis of the bone anomalies and changes observed in the MB61-00562 female skeleton.

MB61-00562 Main paleopathological features: Marked asymmetry of the left *os coxae* with acetabular changes/absence of the left femoral head and neck.
Differential diagnosis: acetabulum and intracapsular fracture at a young age. The marked asymmetry of the left *os coxae*, the absence of a true acetabular fossa, and the presence of a shallow and irregular acetabular rim seem compatible with a case of premature closure of the triradiate cartilage. After trauma, premature closure may result from the formation of a bony bridge across the epiphysis due to the ossification of an existing hematoma or of a displaced bone fragment (Scuderi and Bronson, 1987 and authors herein). An early-age proximal femoral fracture, followed by head reabsorption, is the best explanation for the absence of femoral head, robusticity asymmetry in the upper and lower limb, and severe knee osteoarthritis on the opposite side.
Conditions not completely ruled out from the differential diagnosis: **Septic arthritis** — although SA has been considered thoroughly, a post-septic hip has a multitude of presentations, including avascular necrosis (Vidigal et al., 1998), hip arthritis, and limb shortening, there is a lack of evident signs of infection, like new bone formation or cloacae (Zhan et al., 2023), and the hip remains mobile. Ankylosis is a common consequence of SA (Waldron, 2009). The degenerative changes seen in the left acetabulum, left femur proximal extremity, and right distal femur exhibit significant similarities, such as joint surface exostoses and advanced stages of hypertrophic bone formation (Ortner, 1968; Buikstra, 2019), thus, it is reasonable to assume a common aetiology.
Conditions ruled out from the differential diagnosis: **Tuberculosis, syphilis, and cancer metastasis** — none of their most distinctive features were observed in the skeleton. No signs of lytic or proliferative lesions were observed on the skull, ribs, vertebrae, or long bones (Waldron, 2009; Buikstra, 2019). **Sickle cell disease** — can cause osteonecrosis of the femoral head, but in clinical cases, the manifestation is often bilateral (Daltro et al., 2018), which was not observed in the present case. **Poliomyelitis** — conditions that cause limb paralysis during childhood (in a growing skeleton) may induce limb asymmetry. In these cases, the affected limb is often much shorter and gracile than its antimere. This condition also predisposes bone to fragility fractures (Liverse et al., 2008; Waldron, 2009; Novak et al., 2014). However, in the present individual, the difference is mainly related to robusticity in the shaft and proximal and distal ends of the bone, and not bone length. **Congenital hip dysplasia** — the most common features — e.g., a false, but round, oval, or crescent-shaped acetabulum were not observed. Moreover, it is not associated with head disappearance (Mitchell and Redfern, 2008).

similar to the 562 case. In both individuals, the affected acetabulum concavity is shallow. Both show sclerotic bone, but in the Zhan et al. (2023) case, the destruction of the acetabulum was much more pronounced, and the authors identified signs of infection, such as several cloacae in the acetabulum and porous bone formation on the proximal femur, which we could not identify. Zhan et al. (2023) acknowledge that conditions secondary to trauma could produce similar pathologies, but no fractures were identified in their case (see Buikstra, 2019). Not many examples of fractures with evidence of infection exist in the archaeological record (Buikstra, 2019). A possible explanation is that individuals would not survive long enough for remodelling to occur. The non-occurrence of open fractures in the past does not seem a plausible hypothesis. A key distinguishable feature in septic arthritis is that the edge or margin of the affected bone is less sharp than in other forms of arthritis (Burt et al., 2013), but there are no features of septic arthritis that are unique to the condition (Buikstra, 2019).

In paleopathology, the identification of childhood trauma in the adult skeleton is challenging (for a review see: Verlinden and Lewis, 2015; Lewis, 2018). Limb asymmetry/deformity is regarded as an indirect indicator of physeal trauma and arrested growth in children (Lewis, 2018). Some examples regarding the upper limb bones have been published in the palaeopathological literature (e.g., Glencross and Stuart-Macadam, 2001). However, to our knowledge, no cases affecting the hip bone have been reported to date. This female also displayed nose and rib fractures. Although it is not possible to know if all fractures occurred in the same event, it is still interesting to note that this woman suffered injuries in different bones in her lifetime.

Impact of bone changes on the individual's life

The observed bone lesions provide evidence of a life characterized by enduring disability, yet also by resilience. An early-age trauma episode, albeit restricted to the left hip, must have had a bigger impact on the biomechanics of the lower limb. LLA may cause joint instability since it alters gait symmetry and the dynamics of the locomotor system during weight bearing. For example, the slight torsion and increased inclination angle of the right femoral neck – coxa valga, can be interpreted as a compensatory mechanism. The presence of eburnation (although a small patch), bone of increased density (sclerotic), and osteophytes on the proximal left femur, indicating the formation of a pseudo-joint, aligns with the likelihood of mobility to some extent, potentially with the assistance of a cane or crutch (Belcastro and Mariotti, 2000; Redfern and Austin, 2020). As all the lower limb bones of the left side, including the femur, tibia, patella, and tarsals, exhibit a smaller size, except for the metatarsals and toes, it is reasonable to infer that walking was greatly compromised. The column is also affected by osteopenia. Reduction of muscle mass can be seen after the use of a sling or crutch to maintain the limb in suspension. In fact, immobility alone, even for short periods, impacts virtually all body systems (e.g., musculoskeletal, physiological, metabolic, respiratory, and even mental) because they do not function in isolation (Tilley, 2015). Even in healthy older adults, bed rest has been shown to cause muscle wasting within 10 days and more than 1% loss in bone density within the vertebral column (Parry and Puthucheary, 2015). However, some weight was still borne on the left foot to compensate for the uneven leg length, which could explain the lack of asymmetry on the metatarsals and the MT1 distal joint extension (Lovell, 2016). Additionally, the pronounced disparity in length between the right and left clavicle (in humans, the clavicle of the dominant side is usually shorter; Mays et al., 1999), coupled with a bias towards right-side asymmetry in the attachment areas of the pectoralis major and teres major muscles, suggests a history of unequal loading with greater demands on the right side. However, both shoulders and elbows show degenerative changes. Moreover, one cannot exclude a possible relationship between this female's LLA and the severe osteoarthritis manifest in her right knee and some tarsal bones. Dixon and Campbell-Smith (1969) in their examination of clinical cases of LLA identified a heightened incidence of degenerative joint changes in the longer limb's knee in comparison to the shorter limb.

Finally, the anomalies observed at the base of the cranium seem to be developmental in origin and possibly arise from a failure in bone segmentation. Clinically, these defects may be asymptomatic or, if responsible for stenosis of the artery, may provoke significant discomfort, including migraines, vertigo, confusion, altered consciousness, or motor weakness. It is meaningful to note that the cause-of-death listed in this case was psychotic schizophrenia, and several studies have found a high percentage of minor physical anomalies, particularly around the head and neck, among schizophrenic patients (McGrath et al., 1995; Compton and Walker, 2009; Tsehay and Shitie, 2020). The explanation for this association is that both result from genetic and environmental disturbances on development that occurred during the intrauterine and perinatal periods that predispose to developing schizophrenia. Despite the relationship between these craniocervical anomalies and some neurological symptoms, including being on bed rest during most of the day (Lvov et al., 2017), it is impossible to know for sure if their presence has affected the mental health of this woman.

Conclusion

The article described a spectrum of bone changes observed in a female skeleton from the Luís Lopes Collection, 20th-century Lisbon, who died from psychotic schizophrenia. Despite being an identified case, the available information contributed little to the differential diagnosis.

It was difficult to establish any definitive connection between the cause of death listed and the bone changes observed on the left hip, which portrays some of the limitations of the reference collections. Even so, the present case is relevant to palaeopathological knowledge. It described a rare case of an acetabulum and intracapsular fracture that occurred at a young age (before acetabulum fusion was completed) and was responsible for the absence of the femoral head, severe lower limb asymmetry, and knee and tarsal osteoarthritis on the opposite side. It also discusses the health significance of a cluster of minor congenital defects on the base of the skull and cervical region. The bone lesions reveal a life marked by permanent impairment but also by resilience. This female survived a severe hip injury that likely occurred before adulthood, probably being cared for by family or community members during the period of recovery, but resumed her mobility, although with severe limitations, after the injury healed. This case holds palaeopathological significance as it informs researchers about a spectrum of bone changes that can be used for diagnosing hip trauma in growing individuals during periods with limited access to modern professional healthcare, as was the situation throughout human history and remains the reality in many countries today.

Conflict of interests

The authors disclose no conflict of interest.

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