Case Report

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Simultaneous Bilateral Femoral Neck Fractures Due to Vitamin D Deficiency and Chronic Ankle Instability in a Young Adult -- A Case Report and Literature Review

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Abbreviations: CT: Computed Tomography; MRI: Magnetic Resonance Imaging; SLRT: Straight Legs Raising Test; CAI: Chronic Ankle Instability; CRIF: Closed Reduction and Internal Fixation; THR: Total Hip Hemiarthroplasty; THA: Total Hip Arthroplasty; AVN: Avascular Necrosis; NWB: Non-Weight Bear; PWB: Part-Weight Bear

ABSTRACT

Background: Simultaneous fracture of bilateral femoral necks is a rare case. The femoral neck is a key position of stress on the upper and lower limbs. The femoral head necrosis may be caused by the injury, which is often paid close attention to by trauma surgeon. Fractures due to trauma are categorized as fatigue fractures, and fractures due to pathological factors such as vitamin D deficiency, hyperparathyroidism and chronic renal failure are categorized as dysfunctional fractures

Case Presentation: This case described a 30-year-old young male patient with bilateral femoral neck fractures after a short jog. MRI be diagnosed as Garden I type; CT showed mild hip osteoporosis; Laboratory index showed vitamin D deficiency and other performance are normal. He had a history of chronic ankle instability due to the right ankle sprain. Under the guidance and advice of doctors, the fracture achieved recovery after conservative treatment.

Conclusion: The young adult caused by low-energy occult bilateral femoral neck fracture in the early diagnosis is not obvious. Femoral neck fracture in the early X-ray slice is difficult to determine and easy to be misdiagnosed as synovitis of the hip or traumatic arthritis, so that the clinical intervention time was delayed. To avoid fracture displacement and femoral head necrosis, the patient of femoral neck mild fracture requires complete non-weight bearing for 8-12 weeks and part weight bearing for 4-6 weeks; In order to prevent osteomalacia, more severe osteoporosis and abnormal bone metabolism causing convulsions or epilepsy, punctual vitamin D supplementation and reasonable exposure to sunlight is considerable. Timely and effective surgical intervention is necessary for the complete and displaced fractures. CT, MRI, laboratory examination and comprehensive inquiry are helpful to diagnose and eliminate misdiagnosis. Diseases that affect metabolic processes, such as smoking, long-term stay up and severe fatty liver, can be also result in to bilateral femoral neck fractures.

Introduction

Cases of unilateral femoral neck fracture are often encountered clinically. Studies have confirmed that femoral neck fracture on one side often leads to secondary fractures on the other side due to increased compensatory force on the undamaged side [1]. However, Simultaneous bilateral femoral neck fracture is very rare, which is more difficult to detect in the young patient population. It usually occurs in traumatic situation, such as accidental electric shock [2-5]. traffic accident [6-8], The recruit training [9,10], high or sudden fall [11,12], weight lifting [13], etc. There are also secondary to pathological condition, The etiology due to hyperparathyroidism or osteomalacia caused by vitamin D deficiency [14-22], epileptic seizure [16-25], chronic renal insufficiency [25,26], secondary metabolic disorder of malnutrition [26-30], postoperative joint replacement [31], drugs of Allen phosphonic acid or sugar cortical hormone [32], narcotic drug abuse [33], abnormal bone metabolism and bone resorption on account of metastatic tumor [34], etc. The etiology of this kind of fracture is complex and the condition of a patient is occult. Early X-ray examination is difficult to diagnose and is often misdiagnosed as hip arthritis or synovitis, which delays the treatment and leads to irreversible damage such as delayed or non-union of bone, even avascular necrosis of femoral head. Timely MRI and comprehensive inquiring are helpful for early diagnosis and clinical intervention. This article describes a 30-year-old patient with habitual falls due to chronic ankle sprains，osteoporosis due to vitamin D deficiency and bone metabolic disorders due to fatty liver, who is diagnosed as bilateral femoral neck fractures(Garden I type). He was taken conservative remedial measures with no weight bear 2 months and part weight bear for 1 month, in addition to non-highlight insolation and nutritional supplements. Ultimately the fracture was completely healed, Except for fatty liver, other index was normal, and the patient returned to daily work and life after 1 year follow-up visit. The article was written and published with the informed consent of patients.

Case Report

This case describes a 30-year-old male patient with bilateral femoral neck fracture after a short jog, he was labeled as an office worker，smoker，nightbird and fatty liver. One month before, because of his overweight(The body mass index = 25.68 kg/m2) the patient undergoes consecutive jogging about two kilometers per time. After the warm-up exercise on the fourth day, it was happened to the symptom of severe bilateral groin pain and swelling, which is aggravated by high knees lifting，stomping, and sneezing , meanwhile, it is eased by sit rest and hot compress. Physical examination is showed a positive result of Straight legs raising test(SLRT)，Heel strike test and Patrick 's test, The myodynamia the of bilateral lower limbs are V level. No abnormalities were found in the X-ray plates at the local hospital, it was considered as the hip arthritis. The resident prescribed Diphen (Diclofenac sodium Double Release Enteric capsule) and Huoxuezhitong capsule (Chinese patent medicine) for anti-inflammatory and analgesic with symptomatic treatment, however, no improvement was found, so he was transferred to our hospital. Computed tomography (CT) showed bilateral femoral neck incomplete fracture (Garden I type) and double hip mild osteoporosis; Magnetic resonance imaging(MRI) include TI-weight, T2-weight, and short-time inversion recovery(STIR) saw the fracture line and the surrounding callus, no tumor space-occupying lesions, bilateral bone structures are normal (Figure 1).

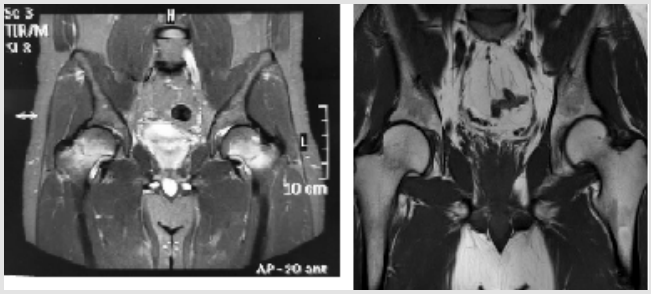

Figure 1: MRI of the patient was compared before and after the treatment
(A) The first MRI of STIR after injury which reveals a bilateral femoral neck fracture and diffuse edema at the fracture site.
(B) The 6 months MRI after injury which shows the bilateral healed fracture line.

Laboratory tests showed: abnormal vitamin D:17.8 ng/ml (normal 30-100ng/ml), Previous high blood lipids including triglyceride，low density lipoprotein，high-density lipoprotein，total bilirubin，direct bilirubin, other blood indicators were normal, including blood cells, ESR, CRP, RF, HLA B27, ALP, Ca, P etc. (Table 1). A detailed inquiry revealed that the patient had a history of chronic ankle sprains, and the sequelae were chronic ankle instability(CAI), The clinical manifestations are easy to have a fall when walking and climbing stairs, For the past 2 months, The patient had fallen 6-8 times during walking up and down stairs, which may be the direct traumatic factors of fatigue fracture. The patient's parents have various degrees of hypertension and diabetes, and no other related genetic diseases have been found. Final diagnosis determination: Bilateral femoral neck fatigue fracture (Garden I type); Vitamin D deficiency; Severe nonalcoholic fatty liver disease; Chronic ankle instability. To avoid the fracture displacement and return to normal activities as soon as possible, He was taken conservative remedial measures with no weight bear for 2 months and part weight bear for 1 month, to improve the vitamin D deficiency ,in addition to non-highlight insolation and nutritional supplements. the fracture was completely healed after 6 months, no complications including necrosis of the femoral head

and secondary osteomalacia etc. Except for fatty liver, keeping the Vitamin D level close to normal and other index were within normal range, the patient returned to normal work and life during extra 1 year follow-up visit.

Table 1: Laboratory data during patient's visit ↑ suggests indicators are on the high side; ↓suggests indicators are on the low side; The amount of ↑ and ↓ reflects the severity.

Test item	Abbreviation & Units	Value	Normal range	
Erythrocyte sedimentation rate	ESR (mm/h)	10		0-21
Serum rheumatoid factor	RF (IU/ML)	9.5		0.00-15.00
Anti-streptococcal hemolysin"O"	ASH-O (IU/ML)	187		0.00-200.00
Human leukocyte antigen B27	HALB 27	(-)		(-)
C-reactive protein	CRP (mg/L)	1.92		0.00-10.00
Glutamic-pyruvic transaminase	ALT (U/L)	64		0-64
Glutamic oxalacetic transaminase	AST (U/L)	34		0-64
Total Bilirubin	TBIL(μmol/L)	22.1	↑	3.4-20.5
Direct Bilirubin	DBIL(μmol/L)	7.5	↑	0-6.8
Alkaline phosphatase	ALP(U/L)	73		40-150
Urea	UREA(mmol)	4.4		2.5-8.5
Creatinine	CREA(μmol/L)	92.1		44-130
Glucose	GLU(mmol)	4.8		3.5-6.5
Uric acid	UA(μmol/L)	356		210-430
Triglyceride	TG(mmol/L)	3.93	↑	0-1.8
Total Cholesterol	CHOL(mmol)	5.88		2.84-6.20
High-density lipoprotein	HDL(mmol)	1.00	↓	1.04-1.68
Low-density lipoprotein	LDL (mmol/L)	3.92	↑	<3.37
Calcitonin	CT (ng/L)	0.62		0.00-9.52
Parathyroid Hormone	PTH (pg/ml)	46.66		15.00-65.00
25 hydroxyvitamin D	25(OH)-D(ng/ml)	17.8	↓↓	>20.00
Human mid-segment osteocalcin	N-MID (ng/ml)	14.66		14-42
Serum free Triiodothyronine	T3 (nmol)	1.98		0.89-2.44
Serum free Thyroxine	T4 (nmol)	102.17		62.67-150.84
B-collagen special sequence	B-CSS (ng/ml)	357.8		<584
Thyroid-stimulating hormone	TSH(μIU/ml)	1.77		0.35-4.94
Calcium	Ga(mmol/L)	2.43		2.08-2.60
Magnesium	Mg(mmol/L)	0.9		0.65-1.05
Phosphorus	P(mmol/L)	0.83		0.80-1.60

Discussion

Femoral neck fracture is a common orthopedic disease. Due to its occult location and weak blood circulation, its diagnosis and treatment are complicated. Improper treatment may cause fracture nonunion or even necrosis of the femoral head, which will bring lifelong pain and lameness to the patients. Simultaneous bilateral femoral neck fracture is rare in clinic, past the old case only 31 cases in young people (Table 2), the most common cause of accidental electric shock, seizures, recruits training, chronic renal failure, vitamin D deficiency cause osteomalacia and osteoporosis, hyperparathyroidism and other metabolic dysfunction disease. This article describes the case is a 30-year-old young people because of chronic ankle instability, lead to overall instability of lower limb lines of force [35], too much load to the femoral neck

the maintaining of the key parts of the onset of coordination and balance, the burden of femoral neck becomes overweight, the constant bony destruction causes inflammatory factor invasion, leading to increased bone remodeling, eventually lead to local micro fracture. Other etiological factors is the osteoporosis caused by a lack of vitamin D [36], the reason comes down to the patient working all of the day night and less sun exposure[37], patients with abnormal liver function[38] is also an important reason resulting in abnormal bone metabolism index, Vitamin D is key molecules, in bone metabolism in liters of blood calcium effect of the parathyroid hormone and calcitonin balance effect between role in blood calcium.

Table 2: Literature review associated with Simultaneous bilateral femoral neck fractures in young patients.

Reference	Age & Gender	Type	Pathogenesis	Treatment	Outcome	Osteoporosis
Arisumi S, [1]	33,male	R: Garden II; L: Garden III	Secondary severe osteoporosis of vitamin D deficiency	Bilateral osteosynthesis using the multiple pinning and Drug supplement	Recovery after 8m	yes
Fukui K, [2]	51,male	B:Konan's zone 2 grade 1	Secondary osteoporosis and osteomalacia of vitamin D deficiency	Bilateral CRIF with cannulated screws and Drug supplement, NWB for 1W and PWB for 1m	Recovery after 1y	yes
Chandankere V, [3]	16,boy	B: GargenIII; Delbet II	Secondary hyperparathyroidism of vitamin D deficiency and seizures	Bilateral CRIF with 6.5-mm cancellous screws and and Drug supplement, NWB for 3m	AVN of the left hip and implant removal, poor functional result after 13m	null
Hernigou J, [4]	38,female	R:Garden II; L:GardenI	Heavy exercise after recovery from anorexia nervosa and amenorrhea	Bilateral osteosynthesis was performed with a dynamic hip screw (DHS) plate and and Drug supplement for 2y	Recovery but retain osteoporosis	yes
Uzun E, [5]	26,female	B:GardenI; Deformity of the femur	Hypophosphatemic rickets in postpartum period and osteoporosis	Bilateral cementless THA respectively and corrective closing wedge osteotomy	Delayed union of right femoral after 12m	yes
Freitas A, [6]	49,female	B:Garden III	Regular dialysis for renal osteodystrophy for 15 years,Avascular necrosison both femoral heads	Bilateral cementless THA	Better functional after 6m, and recovery after 4y	yes
Sariyilmaz K, [7]	26,female	B:GardenI, Deformity of the hip joint	Osteomalacia , coxa vara, Secondary hyperparathyroidism of vitamin D deficiency	R: Hip Pauwels valgus osteotomy with a 135-angled plate L: Same osteotomy after 3m	Normal action after 3m,Recovery after 2y	null
Khadabadi NA, [8]	25,male	B:GardenI;	Lifting heavy objects Continually, Fatigue fracture	Bilateral CRIF with a 3 holed dynamic hip screw	Recovery after 1y	no
Sathyanarayana V, [9]	23,male	B:Garden III	Chronic renal failure and reflux nephropathy; haemodialysis; hyperparathyroidism	Bilateral cementless modular bipolar THA	Hospital discharge after medically stable 11d and weekly twice sustaining dialysis	yes
[10]	52,male	B:Garden IV	Severe traffic accident	Bilateral CRIF with 3 canulated screws	Recovery after 1y	no

Selek O, [11], 3cases	30,female 35,female 30,female	null	Secondary hyperparathyroidism of vitamin D deficiency; Osteomalacia; iron deficiency anemia; celiac disease	All : Bilateral CRIF with cannulated lag screws	Recovery: Case 1 had 4years; case 2 had 28months; case 3 had 2years	yes
Sadeghifar A, [12]	25,male	B:Garden II; multiple fracture	Motor vehicle accident	Bilateral fixed using in situ screws	Recovery after 8m	no
Mariani P, [13]	24,male	B:Garden IV	Spastic diplegia from a cerebral palsy	Bilateral THA	Recovery after 2y	no
Sohal HS, [14]	20,male	B:Garden III	Electrical shock injury and fell backwards on his buttocks	Bilateral CRIF with 3 canulated screws	Recovery after 16m	no
Nemoto O, [15]	24,male	R: GardenI; L: Garden II	Routine military training	Bilateral CRIF with 3 canulated screws	Recovery after 6m	no
Naranje S, [16]	34,male	B:Garden II	Routine military training	Bilateral CRIF with 3 canulated screws	Asymptomatic but slight limp after 1y	no
Hootkani A, [17]	28,male	R: Garden II; L: Garden III	A history 10y of narcotic drug abuse and 8m bilateral groin pain and osteonecrosis	Bilateral THR	Recovery after 6m	no
Grimaldi M, [18]	49,male	B:Garden IV	Idiopathic epileptic seizure, and 5y medical history of Gabapentine; Vascular osteonecrosis	Bilateral THR	Recovery after 12m	no
Nagao S, [19]	36,male	R:Garden II; L:Garden III	Secondary osteoporosis of vitamin D deficiency, coxa vara	Bilateral CRIF with three cannulated cancellous titanium hip screws and 1α(OH) vitamin D3 and calcium supplements	L: Coxa vara still not correct and the absence of bony union, Femoral head arthroplasty of the hip was executed	yes
Pankaj A, [20]	58,male	R:Garden IV; L:Garden III	3y history of osteoarthritis of both knees and after operation of bilateral Total knee arthroplasty(TKA)	R: a modular cemented bipolar arthroplasty; L: CRIF with cannulated screws	Recovery after 3m	no
Gilban HM, [21]	5.5,girl	B:cervico-trochanteric femoral neck fractures	Severe traffic accident	Bilateral CRIF with threaded canulated screws	R:Recovery after 3m L:Delayed union and AVN after 16m	no
Upadhyay A, [22], 2cases	11, boy 8, girl	case1. R:Garden IV; L:Garden II case2.R:Garden III; L:Garden II	Falling from high position	Bilateral CRIF with canulated screws	Recovery after 8w (12w) and returned to full activity at 20m (30m)	no

Rahman MM, [23]	30,male	B:Garden IV	Epileptic seizure	Bilateral CRIF with the dynamic hip screw and plate system ,Drug supplement of anti-epileptic treatment	Recovery after 6w,returned to full activity at 3y	no
Negishi H, [24]	29,female	B:Garden IV	Primary hyperparathyroidism (PHP) and falling during pregnancy	Bilateral CRIF with multiple pinning postpartum, and parathyroidectomy	Recovery after 10m	yes
Khalily C, [25]	47,female	null	Bone metastatic adenocarcinoma from breast cancer	Bilateral cementless THR and chemotherapy	Disease progressed 36m and the ofimplant hadn't loosening after 56m	null
Chadha M, [26]	24,female	B:Garden IV	Secondary osteomalacia of vitamin D deficiency	Bilateral CRIF with a muscle-pedicle bone graft	Fracture healing after 1y	yes
Madhok R, [27]	24,female	null	Chronic renal failure and epileptic seizure	Bipolar cement THR	Hip asymptomatic after10y	null
Slater RR Jr, [28]	41,male	B:Garden IV	Electrical shock and burn injury of 4000V	Bilateral CRIF with AO canulated screws	null	no
Tompkins GS, [29]	41,male	B:Garden IV	Electrical shock injury of 4000V	Bilateral CRIF with canulated screws	Hospital discharge after 8 day and no follow-up	null
Vento JA, [30]	53,male	R:Pauwell III; L:Mild fracture	Jogging and forced to step back to avoid being hit	Bilateral CRIF with the knowles pins and compression screw plate system	null	null
Shaheen MA, [31]	25,male	null	Electrical shock injury of 210V	Bilateral CRIF with a nail and plate	Hospital discharged after 6 w, and Recovery after 1y	null

Note: B:Bilateral; L:Left; R:Right; CRIF:Closed reduction and internal fixation; THR:total hip hemiarthroplasty; THA:total hip arthroplasty; AVN:Avascular necrosis; NWB:non-weight bear; PWB:part-weight bear; y:year(s); m:month(s); w:week(s); d:day(s); V:voltage; null:not mentioned.

the first hydroxylated vitamin D3 in the liver forms 25-(OH)-vitamin D3,which promotes bone formation, the second hydroxylates in the kidney forms vitamin D, which promotes the calcium ion of original urinary being absorbed into the bloodstream. Vitamin D deficiency often leads to abnormal blood bone metabolism-related indicators such as Ga, P and Mg, and eventually decreases femoral bone mineral density and increased susceptibility of micro-fractures. Furthermore, poor lifestyle habits such as smoking [39] and staying up late [40] can also lead to changes in bone mineral content and even fractures. Based on previous clinical practice, according to the severity of fracture (Garden I type) and the clinical cases reported in the literature, therefore we chose conservative treatment strategies, namely the weight 2 months, part weight bearing a month, and every day low-light sun exposure. eventurely we found the bilateral healed fracture line, regular follow-up showed that he had restored to the normal work and life. Previous treatment methods have focused on high-cost surgical therapy such as internal fixation or hip arthroplasty. This case provides clinicians with a new treatment idea.

Conclusion

Bilateral femoral neck fracture is very rare, early clinical feature is difficult to detecte. Garden type I is harder to come across. For common patients with femoral neck fractures, surgical operative treatment is the usual strategy. this patient had a satisfactory curative effect after conservative treatment. This case provided a reference for future clinicians.

Declarations

Ethics Approval and Consent to Participate: Not applicable.

Consent for Publication

Written informed consent was obtained from the patient for publication of this case report, along with any accompanying images. A copy of the written consent is available for review by the Editor of this journal.

Availability of Data and Material

All data concerning the case are presented in the manuscript.

Competing Interests

The authors declare that they have no competing interests.

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Author's contribution

a. Conceptualization, Writing of manuscript, Literature review,Patient consultation and follow-up: SJ.

b. Diagnosis and treatment of patients,Reviewing and decidng the final version of the manuscript: ZYL.

c. Data collections and arrangements: WYQ; LJQ

d. All authors have read and approved the manuscript and ensured this is true.

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