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Leg length asymmetry in stress fractures

A clinical and radiological study

by

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INTRODUCTION

In the majority of cases of stress fractures, the lesion or at least the subjective and clinical symptoms as well as the x-ray findings are unilateral^{2 3 4 6 13 15 17 18 20 22} although some bilateral or even multifocal reactions in several bones have recently been found by radionuclear methods.^{15 17 18}

On the other hand, it has been suggested that even minor leg length asymmetry that might cause little or no difficulty in the non-athlete, can cause significant symptoms in the active athlete.²³ It has also been demonstrated by electromyography that a leg length discrepancy of less than 10 millimeters can lead to remarkable increase in the activity of several muscle groups and make it impossible to maintain a complete resting position.¹⁹

The present study was undertaken in order to throw some light to the predisposing and etiological factors in the pathogenesis of the stress fractures and to get some idea why the lesion sometimes develops in the right extremity and sometimes in the left although when walking, running or marching both lower extremities ought to be equally stressed. The purpose of this study is to investigate the role of unequal leg length in the development of stress fractures of the lower limbs.

MATERIAL AND METHOD

As the clinical methods for measuring the leg length are too inaccurate for scientific examinations¹⁹ and the conventional radiological methods²⁴ are too complicated to be performed and the high radiation doses make them unethical for mass examination, a simple standing x-ray method has been developed in Military Hospital 3 in Finland.^{6 7 8} In this method only the regions of the femoral heads are x-rayed, the region of the gonads being protected with a special broad lead shield. There is a ruler with thin horizontal copper markers between the patient and the film. The radiation doses for gonads and for the bone marrow have been measured by the Institute of Radiation Protection in Helsinki and have been found to be minimal and risk-free.⁷

Altogether 371 Finnish Army conscripts aged 18 to 25 years were included in this study, 130 of them suffering stress fractures diagnosed both clinically and radiologically. A group of 102 parachutists in an extremely heavy training period of 330 days was also included in the study. The stress fractures developed in this group were similarly diagnosed and thereby verified by radionuclear methods.¹⁵ A group of 164 healthy recruits were used as a control group in the beginning of their duty.

The leg length asymmetry of each subject was measured by the method described above. The results were in 10 cases compared with the results obtained by the orthoradiological method²⁴ and in 10 cases the measurement with the authors method was repeated 1 to 10 months later. The results were found to be exact and reliable.

RESULTS

Of the total material 31.5% had a longer right leg and 52.6% had a longer left leg, whereas 15.9% had symmetrical leg lengths.

Of all 130 stress fracture patients 114 (88%) had a unilateral and 16 (12%) a bilateral lesion. Of the 114 unilateral lesions 71 (62%) occurred in the left lower extremity and 43 (38%) in the right one.

In the control group of 176 conscripts 47.5% of subjects had a leg length discrepancy of 5 mm or more as the percentage in the group of 130 stress fracture patients was 57.7 (Table 1).

TABLE 1.—*Leg length discrepancy in the control group and in the patients with a stress fracture in tibia, metatarsals or femur.*

Leg length discrepancy mm	Control group		Patients with stress fracture	
	No.	%	No.	%
0	27	16.5	21	16.1
1 - 4	59	36.0	34	26.2
5 - 9	45	27.4	36	27.7
10 or more	33	20.1	39	30.0
Total	164	100.0	130	100.0

The unilateral stress fractures of tibia, metatarsals and femur occurred in the longer extremity in 73% of the cases and in the shorter leg in 16% only. The fractures of fibula, however, were found in the shorter leg in 60% of the cases (Table 2).

It was observed that the majority of the patients with a unilateral stress fracture had a leg length asymmetry of 5 mm or more. On the contrary, the bilateral lesions occurred in subjects with equal or almost equal leg length, the discrepancy never exceeding 3 mm.

The leg lengths of 102 parachutists were measured in the beginning of their service. During an extremely stressing physical training period of 330 days, altogether 25 of the subjects developed a stress fracture. The incidence of the stress fractures seemed to correlate with the quantity of the leg length discrepancy (Table 3).

DISCUSSION

The asymmetry of leg length is a common phenomenon,^{1 10 11} the left leg being longer in the majority of the cases^{5 11 16} as also found in this study. The leg length asymmetry can be considered as a normal variant, the subject himself as well as the physician making the clinical examination both generally being unaware of an asymmetry of even twenty mm.¹⁸ In physical stress situation, however, the leg length asymmetry seems to be liable to cause several kinds of troubles in the musculoskeletal system.^{6 7 8 18 22}

TABLE 2.—*Location of unilateral stress fractures.*

Fractured bone	Total No.	Longer leg		Shorter leg		Equal legs		Total %
		No.	%	No.	%	No.	%	
Tibia	89	65	73.0	15	16.9	9	10.1	100.0
Metatarsals	10	7	70.0	1	10.0	2	20.0	100.0
Femur	5	4	80.0	1	20.0	—	—	100.0
Total	104	76	73.1	17	16.3	11	10.6	100.0
Fibula	10	2	20.0	6	60.0	2	20.0	100.0

TABLE 3.—*The incidence of stress fractures in different groups of leg length (parachutists).*

Leg length discrepancy	Total No.	Stress fractures	
		No.	%
0	13	2	15.4
1-4 mm	36	6	16.7
5-9 mm	37	9	24.3
10-14 mm	13	6	46.2
15-20 mm	3	2	66.7
Total	102	25	24.5

In the present study the stress fractures of tibia, metatarsals and femur occurred in 73% of the cases in the longer leg and in 16% only in the shorter leg. Although the number of patients with stress fracture in metatarsals, femur or fibula is small, the present results can be interpreted as a suggestion for the predisposing role of the leg length asymmetry in the pathogenesis of the stress fractures of the lower limbs. It is suggested that the asymmetry of balance and unequal torsion of bones as well as the increased muscular activity in the asymmetrical extremities^{19 23} may in prolonged or repeated physical stress situations affect the outcome and the location of the stress fracture.

As an exception from the other stress fractures the occurrence of the fibular stress fractures in the shorter leg might, in 60% of the cases, have been caused by the tendency of the foot and ankle to turn in the valgus position and rotate outwards in the shorter leg.²² This is the case in the "ice skaters fracture" in the supramalleolar region of the fibula where the fibular stress fractures also in this study were located.

The physical strain of the conscripts serving at the Parachutist School is extremely strenuous and the prevalence of the stress fractures among them is known to be especially high.¹⁵ The positive correlation between the quantity of leg

length asymmetry and the incidence of the stress fractures observed in this study might suggest the need of an early diagnosis of a leg length discrepancy in persons exposed to exceptionally strenuous physical strain. Particularly, because the leg length discrepancies under 20 mm can easily be corrected by a simple heel and/or sole lift on the short leg side.^{17 8 19 23 24}

SUMMARIES

O. FRIBERG

Leg length asymmetry in stress fractures. A clinical and radiological study.

To investigate the role of the leg length asymmetry in the pathogenesis of stress fractures, the leg lengths of altogether 371 Finnish Army conscripts were measured by a standing x-ray method developed by the author. In 130 cases of stress fracture the unilateral lesions of tibia, metatarsals and femur occurred in 73% of the cases in the longer leg and only in 16% of the cases in the shorter leg. In 11% of the cases the legs were of equal length. The stress fractures of fibula, however, were in 60% of the cases located in the shorter leg. In a group of 102 parachutists 25 developed a stress fracture during an extremely heavy training period. A positive correlation between the quantity of leg length asymmetry and the incidence of the stress fractures was observed. It was concluded that leg length asymmetry may have a predisposing role in the pathogenesis and the location of the stress fractures of lower limbs.

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O. FRIBERG

Asymétrie de la longueur de la jambe dans les fractures de stress. Etude clinique et radiologique.

En vue de déterminer le rôle de l'asymétrie de la longueur de la jambe dans la pathogénie des fractures de stress, l'Auteur a examiné les longueurs des jambes de 371 conscripts de l'armée finnoise à l'aide d'une méthode aux rayon X mise au point par lui-même. Dans 130 cas de fracture de stress, les lésions unilatérales du tibia, mes métatarses et du fémur se sont produites dans 73% des cas dans l'extrémité la plus longue

et dans 16% seulement des cas dans la jambe la plus courte. Dans 11% des cas les jambes présentaient une même longueur. Les fractures de stress du péroné toutefois ont été localisées dans 60% des cas dans la jambe la plus courte. Dans un groupe de 102 parachutistes, 25 ont enregistré une fracture de stress pendant une période d'entraînement extrêmement intensif. L'Auteur a constaté une corrélation positive entre l'étendue de l'asymétrie de la longueur de la jambe et l'incidence des fractures de stress. Il conclut que l'asymétrie de la longueur de la jambe peut jouer un rôle de prédisposition dans la pathogénie et la localisation des fractures de stress des extrémités inférieures.

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O. FRIBERG

Asimetría de la longitud de la pierna en las fracturas por "stress". Estudio clínico y radiológico.

El autor examinó la longitud de las piernas de 371 reclutas de la armada finlandesa mediante un método a rayos X perfeccionado por él mismo, con el objeto de determinar el papel que juega la asimetría de la longitud de la pierna en la patogenia de las fracturas por "stress". En 130 casos de fracturas por "stress", las lesiones unilaterales de la tibia, de los metatarsos y del fémur, se produjeron en el 73% de los casos en la extremidad más larga y sólo en el 16% de los casos en la pierna más corta. En el 11% de los casos las piernas tenían una misma longitud. En un grupo de 102 paracaidistas 25 sufrieron fractura por "stress" durante un período de entrenamiento sumamente pesado. Se observó una correlación positiva entre la extensión de la asimetría de la longitud de la pierna y la incidencia de las fracturas por "stress". El autor llega a la conclusión que la asimetría de la longitud de la pierna puede jugar un papel de predisposición en la patogenia y la localización de las fracturas por "stress" en las extremidades inferiores.

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