FEMORAL NECK STRESS FRACTURES IN MILITARY PERSONNEL – A CASE SERIES

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Abstract

Femoral neck stress fractures (FNSF) are uncommon, representing 5% of all stress fractures. In military personnel, FNSF represents one of the more severe complications of training, which can result in medical discharge. Clinical examination findings are often non-specific and plain radiography may be inconclusive - leading to missed or late diagnosis of FNSF. This paper highlights the significance of FNSFs in military personnel and alerts physicians to the potential diagnosis.

We identified all military recruits, aged 17 to 26, who attended the Infantry Training Centre (Catterick, UK), over a four-year period from the 1st July 2002 to 30th June 2006, who had suffered a FNSF. The medical records, plain radiographs, bone scans and MRIs of the recruits were retrospectively reviewed. Of 250 stress fractures 20 were of the femoral neck; representing 8% of all stress fractures and an overall FNSF rate of 12 in 10,000 military recruits.

FNSFs were most prevalent amongst Parachute Regiment recruits (1 in 250, $p< 0.05$). Onset of symptoms was most commonly between weeks 13 – 16 of training. The majority (17/20, 85%) of FNSFs were undisplaced, these were all treated conservatively. Three FNSFs were displaced on presentation and were treated surgically. Overall, the medical discharge rate was 40% (8/20).

FNSFs are uncommon and the diagnosis remains a challenge to clinicians and requires a high index of suspicion in these young athletic individuals. In such individuals early referral for MRI is recommended, to aid prompt diagnosis and treatment and to prevent more serious sequelae.

Introduction

Stress fractures are common injuries, particularly in the lower extremities of athletes and military personnel [1,2]. There are two general types of stress fracture: fractures in which the bone is normal but subject to cyclical loading with abnormal forces (fatigue fractures) and those in which the forces are normal but the bone abnormal (insufficiency fractures) [3]. In either case the fracture occurs due to the imbalance between the repetitive use injury and the intrinsic ability of the bone to repair itself [4]. They tend to present following a recent period of increased physical exercise (or training), and have a higher reported incidence in activities that involve running and jumping [1].

Femoral neck stress fractures (FNSF) are however uncommon, representing between 3.5% to 8% of all stress fractures in military recruits [5-8]. In military personnel, FNSF represents a significant complication of realistic military training that can result in medical discharge [9].

Patients with FNSFs generally present with groin/hip pain, which is common in athletes and military personnel, and can be secondary to a number of pathologies. Clinical examination findings are often non-specific and plain radiography may be inconclusive. Further imaging techniques, such as bone scans or MRI, are therefore often necessary to confirm a diagnosis.

FNSFs can be classified as compression or tension (Figure 1) and undisplaced or displaced [10]. Undisplaced compression insufficiency fractures are the most common and may be treated non-operatively [11]. Tension fractures are at higher risk of displacement and subsequently are associated with increased morbidity, normally requiring operative fixation. Pihlajamaki et al, found that 29% of such patients with displaced FNSFs went on to develop avascular necrosis of the femoral head and a further 38% severe osteoarthritis [12].

This paper aims to highlight the significance of FNSFs in military personnel; report their subsequent outcome in terms of military training; and alert physicians to the potential diagnosis in other at risk populations, which may help prevent serious sequelae in an otherwise fit population.

Methods

We identified all military recruits who attended the Infantry Training Centre (ITC - Catterick, UK) over a four-year period who were diagnosed with a stress fracture, using the EMIS classification codes (or Read Codes) for stress fracture and fractured neck of femur. We then retrospectively reviewed the medical records, plain radiographs, bone scans and MRIs of the recruits with femoral neck stress fractures.

Statistical analysis was performed using Stata 7.0 statistical software (StataCorporation, TX), Chi-square test was used and p values <0.05 were considered statistically significant.

Results

During the four-year period from the 1st July 2002 to 30th June 2006, a total of 250 stress fractures were identified from the 16,713 military recruits who passed through the ITC, representing a rate of 15 per 1,000. Of these 20 were femoral neck stress fractures; representing 8% of stress fractures and an overall FNSF rate of 12 per 10,000 military recruits.

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Rate of Femoral Neck Stress Fracture per Cap Badge

Of the 16,713 recruits 11,590 were Line Infantry recruits, 2,455 Guards recruits, 1,748 Parachute Regiment recruits and 920 Gurkha recruits. The numbers of FNSF and rates per type of recruit are shown in Table 1.

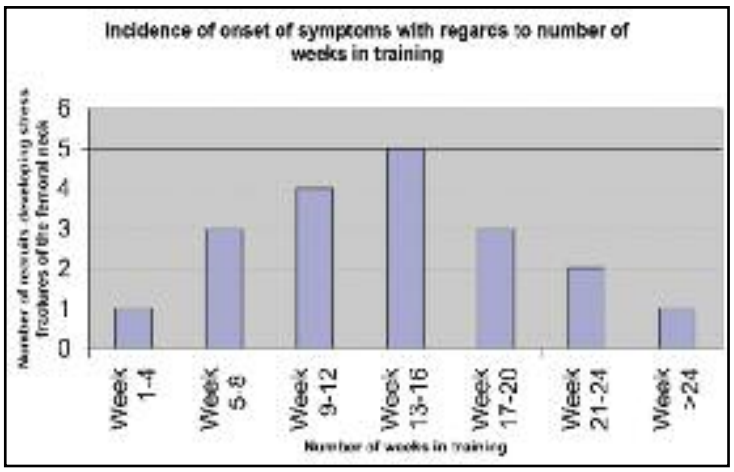
	Overall number of Recruits	Number of FNSF	Rate of FNSF per type of Recruit
Line Infantry	11,590	10	1 in 1159
Guards	2,455	2	1 in 1228
Parachute	1,748	7	1 in 250
Gurkha	920	1	1 in 920

Table 1. Rate of FNSF per type of Recruit.

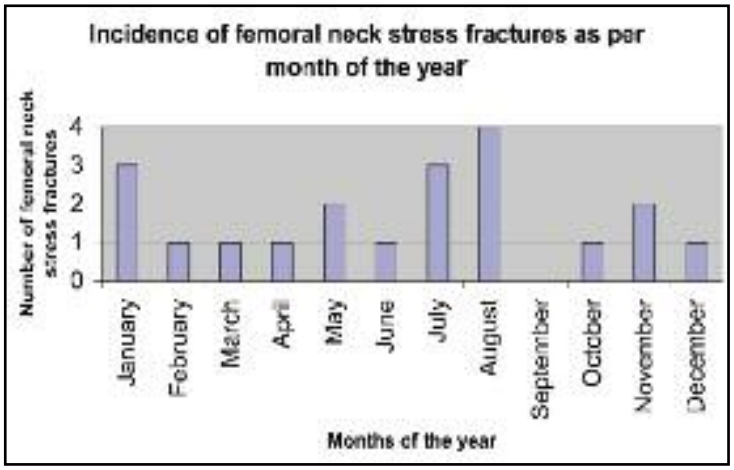
The difference in the rate of FNSF between Line Infantry recruits and Para recruits was statistically significant ($p<0.001$). Similarly there was a statistically significant difference in fracture rates between Para and Guards recruits ($p>0.05$). There were, however, no differences statistically between the other groups. Gurkha numbers were too small to confirm any significant difference between them and any other group.

Onset and Timing of Symptoms

All recruits fitting the case definition had developed hip/groin pain since the commencement of training. Onset of symptoms was documented for 19 out of the 20 recruits, most frequently symptoms appeared between 13 and 16 weeks from the start of training. (Figure 1)



With regards to month of the year and onset of symptoms, there appears to be a bimodal incidence in the summer months and in January. (Figure 2)



Type of Femoral Neck Stress Fracture

Of the 20 FNSFs, 3 (15%) were displaced at the time of presentation and required surgical fixation. One recruit, a Gurkha, returned directly to battalion post-operatively, and the other 2 were medically discharged from the Armed Services. Of these, one developed AVN of the femoral head that required total hip arthroplasty.

Of the other 17 FNSFs; 13 were undisplaced (Figure 3), with 11 of these being of the compression type, across the inferior aspect of the femoral neck; one was a tension type stress fracture; and the other was per-trochanteric extending across the whole neck. Fracture pattern results were not specified in the MRI reports of the other 4.

Figure 3. MRI clearly showing a left sided compression FNSF

Rehabilitation

18 of the 20 recruits underwent a formal graduated rehabilitation programme. This consisted of a 6-week period of remaining partial weight bearing, with the aid of crutches. This was followed by a minimum of 6 weeks pre-recovery training, performing non-impact cardiovascular work. This progressed to 4 weeks of light impact training on a treadmill and then a minimum of 4 weeks of mainstream training, with progressive impact training before progressing on to marching with a 35lb Bergan pack.

Two recruits did not undergo the programme, one was medically discharged from the outset (and no details were available for his subsequent management) and the other, a Gurka recruit, returned to his battalion with no further records being available.

Outcome

Of the 18 recruits who underwent a graduated rehabilitation programme, 12 returned to training (66% success rate 12/20) but only 6 of these passed off to battalion (6/18, 33% success rate). Of the other 6 recruits who returned to training; 3 were medically discharged secondary to the recurrence of hip pain; 2 were discharged on non-medical grounds; and 1 recruit was still in training. Of the 12 recruits that did return to training the average rehabilitation time was 5 months (range 3 to 7 months).

6 recruits did not under go rehabilitation, with 5 being

medically discharged, 4 of them 1-2 months post injury, on account of loss of motivation and 1 being discharged on non-medical grounds.

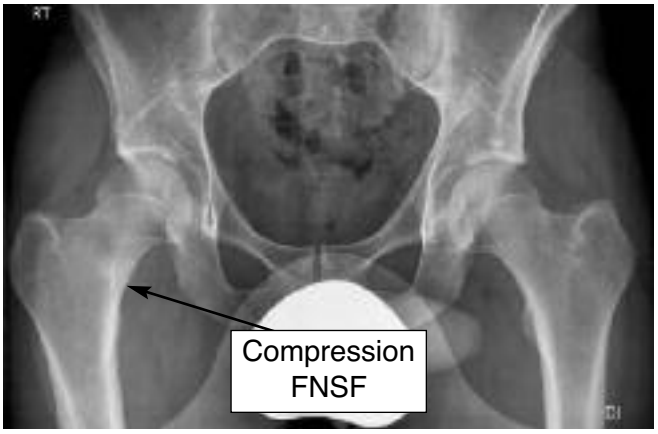


Figure 4. Healing femoral neck stress fracture

Discussion

FNSFs are uncommon and their diagnosis can be easily overlooked or attributed to less sinister pathology; many military recruits (and athletes) present with hip/groin pain secondary to a number of pathologies. Delaying or missing the diagnosis can lead to significant morbidity; particularly with the risk of developing AVN, often requiring total hip arthroplasty in the young patient.

FNSF was first reported by Asal in 1936, although it was Devas in 1965, with a study of 25 patients, who first described the two types of radiological FNSF: tension and compression [10]. Tension type fractures occur along the superior cortex of the femoral neck, while compression fractures are seen along the inferior cortex of the femoral neck. Devas also suggested tension type fractures had a propensity to displace, and subsequent reports have recommended internal fixation for this type of fracture [8]. Compression type fractures are less likely to displace and surgical treatment is, therefore, not generally indicated when these are undisplaced. Their treatment consists of limited weight bearing until fracture union is achieved [14,15].

There are two main theories of stress fracture development. The first suggests that osteoclastic activity is initially higher than osteoblastic activity during initial periods of increased exercise activity [13]. At this time bone is more susceptible to injury, and repetitive injury manifests as micro-fractures that consolidate to form a stress fracture. The second theory suggests the repetitive stresses at insertional points of tendons (and ligaments) result in focal bending stresses that the bone cannot tolerate, resulting in stress fracture [13].

Our series shows that FNSF is uncommon with a total rate of 12 in 10,000 recruits, when compared to a rate of 15 in 1,000 recruits developing any type of stress fracture (e.g. tibial, metatarsal etc). However, the rate of FNSFs in our series appears higher than the reported findings of Pihlajamaki et al, performed on Finnish military recruits; they reported an overall incidence of 3.1/10,000, compared to 12/10,000 noted in this study [12]. Similarly, the incidence of displaced hip fractures, in our study, was 1.8 in 10,000 compared to the 0.16 in 10,000 found by the same paper. This difference may represent a higher 'pick up' rate in our series or possibly be secondary to physiological differences between the British and Finnish populations, or be due to variances in the training regimes.

The results confirm a statistically higher rate of femoral neck stress fracture whilst undergoing training in the Parachute Regiment compared with the Line Infantry. This may be due to the more strenuous training that the paratroopers undergo.

The onset of fracture was highest within the 13-16 week period (5 of 20). This contrasts with the findings of Stoneham and Morgan (1991) who found that Royal Marine Commandos had a highest incidence at the end of their (longer) training [15].

The presentation of FNSFs was highest in the summer months (8 of 20, 40%) and another peak in January. This may be because of ground being harder (dry or frozen) and less compliant, with greater stresses being placed upon the bones, or be related to particular training that is carried out at this time of year.

33% of the recruits with displaced FNSFs (1 of 3) developed AVN, this made up 5% of all recruits (1 of 20). This incidence of AVN, in displaced FNSFs, is similar to that found by Pihlajamaki et al, who found a rate of 29% (6 of 21). [12]

The relatively small number of Gurkha recruits and the longer duration of course (9 months versus 6 months), combined with the assumption that Gurkha recruits are probably more physically robust at recruitment than their British counterparts, makes a direct comparison with other cap badges less likely to be valid.

This study should alert physicians to the potential diagnosis of femoral neck stress fractures, particularly in individuals who have had a recent increase in activity levels or are in other at-risk athletic groups. Most patients have a prodromal period in which there is an opportunity to treat by rest or fix the fracture prior to displacement. Fracture fixation at this point reduces the risk of AVN and the subsequent morbidity associated with it [12]. In our series where displacement only occurred in 3 cases, the medical discharge rate still remained high, despite rehabilitation, at 40% (8 of 20).

Conclusion

The diagnosis of FNSF remains a challenge to clinicians and requires a high index of suspicion in at risk groups. Clinical examination and plain radiography are often inconclusive. Early referral for MRI should be encouraged, especially in paratrooper recruits, to aid prompt diagnosis and treatment. This should prevent the more serious complications of this condition. MRI also has the benefit of avoiding the often larger amounts of radiation required in bone scanning.

Clinical Note:

The results of this case series have already been copied to the Occupational Medicine Branch of the Army Recruit Training Department to alert them to the possibility that a specific sub group of the training population was at risk of this condition as a necessary consequence of the realistic military training undertaken at the ITC.

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