Hypothenar hammer syndrome: a discrete syndrome to be distinguished from hand–arm vibration syndrome

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Background
Hypothenar hammer syndrome (HHS) is a cause of vascular insufficiency to the hand and may be manifest as Raynaud’s phenomenon. The cause is trauma to the vulnerable portion of the ulnar artery as it passes over the hamate bone, which may result in thrombosis, irregularity or aneurysm formation.

Aim
This review was undertaken in order to clarify the features of HHS that may differentiate it from hand–arm vibration syndrome.

Methods
A tiered review of world literature was undertaken using Medline and EMBase as the primary search engines. Fifty-two relevant articles were critically reviewed.

Conclusion
Colour and temperature changes occur more diffusely in HHS than in classical Raynaud’s phenomenon and the absence of the triphasic colour change may alert clinicians to the diagnosis, which may be confirmed by Allen’s test. Doppler or arteriographic studies are required for confirmation. It is important to recognize the possibility of HHS in the occupational setting as a potentially curable cause of Raynaud’s phenomenon, distinct from hand–arm vibration syndrome. The possibility exists of HHS occurring as a result of repeated hypothenar trauma from vibrating tools, in which case the nature and magnitude of the individual episode of trauma may be more important than the weighted acceleration level of vibration exposure.

Key words
Hand–arm vibration syndrome; hypothenar hammer syndrome; lemon squeezer’s hand; occupational; Raynaud’s phenomenon.

Introduction
The term ‘hypothenar hammer syndrome’ (HHS) was suggested by Conn et al. [1] in 1970. Prior to 1982, only 52 cases had been reported of true aneurysms in the hand due to repetitive trauma [2], with 60% affecting the ulnar artery. Although it had been reported as an occupational disease occurring in workers using hammers and screwdrivers, the original description of HHS is generally attributed to Von Rosen [3], who described it as being the result of trauma to the ulnar artery as it courses around the hook of the hamate bone in the wrist (see Figure 1). As it emerges from Guyon’s canal, the ulnar artery is fixed to surrounding structures over a length of ~2–3 cm. Such trauma leads to stenosis or occlusion of the ulnar artery, thereby affecting the blood supply to the superficial palmar arch. A similar condition has been termed ‘lemon squeezer’s hand’ [4].

Occasionally, both radial and ulnar arteries may be affected by such trauma, but usually the pattern of trauma spares the radial artery, allowing some collateral blood flow, albeit often insufficient to ensure adequate blood flow to the hands [5].

The superficial palmar arch is believed to arise entirely from the ulnar artery in 37% of cases. In 16–22% of
patients, the superficial arch is incomplete [6,7]. Conn et al. [1] concluded that the primary lesion was arterial intimal damage leading to thrombosis of the ulnar artery and that medial damage would result in aneurysm formation. Kaji et al. [8] have classified the vascular lesions into three main types, according to the arteriographic abnormality (Table 1). The condition appears to be due to either single or repeated episodes of trauma resulting from use of the hypothenar side of the hand as a hammer, in either work or recreational activities. Ferris et al. [9] reported the largest series (21 cases) of HHS and found that all their cases had repetitive palmar trauma. However, they also found a high incidence of bilateral abnormalities on arteriography, even in patients with unilateral symptoms. They concluded that this finding was evidence that HHS results from trauma to intrinsically abnormal arteries (ulnar artery fibrodysplasia), which would explain the absence of HHS in most patients with repeated palmar trauma. However, they also drew attention to a number of unanswered questions, such as why HHS appears to predominate in men, although there is a preponderance of women in fibromuscular dysplasia series. In addition, they did not examine the more typical locations (renal and carotid) to see if fibrodysplasia was present. Hammond et al. [10] reported a patient with a previously identified abnormally tortuous ulnar artery, who subsequently developed a palmar ulnar arterial thrombosis. Aneurysm of the ulnar artery in the palm has been reported with a congenital origin [11], after mycotic emboli from endocarditis [12] and following penetrating trauma [13]. Rothkopf et al. [14] reviewed 10 cases and found that seven were due to blunt trauma, two to penetrating trauma and one had no history of trauma. An anomalous hand muscle in Guyon’s canal may be related to ulnar artery thrombosis, although the single case report of this identified smoking and blunt trauma as additional risk factors [15]. Okihiro’s syndrome (congenital thenar hypoplasia and Duane’s anomaly) may become clinically significant when HHS develops [16]. Spencer Green et al. [5] observed that arteriosclerosis is generally absent and that the antithrombogenicity of the vascular endothelium is likely to be altered by repetitive mechanical trauma. However, Guarda and Borrerro [17] reported 20 young adult patients with hand and digital ischaemia, all of whom were found to have arteriosclerotic lesions.

Bilateral HHS has been reported with systemic sclerosis, associated with silica exposure (Erasmus syndrome) [18,19].

### Incidence

Although widely regarded as a rare condition, others suggest that it is not so [20]. There are reports of HHS occurring in mountain bikers [21], tennis players [22] and golfers [23]. Other sports implicated include baseball [24], volley-ball [25], badminton, handball, football, frisbee, softball, karate, weight lifting and hockey [26]. The condition has been reported following a bicycle accident [27] and in a drummer [28]. Occupational relationships of HHS are classically that it occurs in the dominant hand of middle-aged craftsmen—manual workers who experienced repeated trauma to the palm of the hand, either because of personal habit or the use of the tools of their trades. Specific jobs implicated have included mining, automobile mechanics [29], sawmill work, carpentry [30], butchery, using the hands to pound steel plates and the use of hammers and screwdrivers. De Gaudermis et al. [31] described the professional activities involved as brick and roughstone laying, tightening of wedge keys or levers, setting in place of hoods and embellishers and kneading of bread dough.

A review of mechanical workshop employees showed that 79 of 127 men were habitual hypothenar hammerers [32]. Of those, 11 (14%) had symptoms of vascular

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**Table 1. Arteriographic patterns of HHS [8]**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>Stenosis of superficial palmar arch around the hook of the hamate</td>
</tr>
<tr>
<td>Type 2a</td>
<td>Occlusion of the superficial palmar arch around the hook of the hamate</td>
</tr>
<tr>
<td>Type 2b</td>
<td>Occlusions of both superficial and deep palmar arches around the hook of the hamate</td>
</tr>
<tr>
<td>Type 3a</td>
<td>Occlusion of the ulnar artery at the proximal part of the wrist</td>
</tr>
<tr>
<td>Type 3b</td>
<td>Occlusion of the ulnar artery near the wrist</td>
</tr>
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</table>

**Figure 1.** Diagramatic representation of the main blood vessels in the hand, showing relationship of ulnar artery to hamate bone.
insufficiency and objective evidence of arterial occlusion, whereas occlusion was found in none of the non-hammerers.

Conn et al. [1] reported 13 ischaemic hands in 10 subjects. Kaji et al. [8] found 24 arteriographically-diagnosed cases among 293 subjects diagnosed as suffering from vibration disease among a population study of 330 workers exposed to vibration in mining, forestry and other industries. Little and Ferguson [32] reported a 14% prevalence of sub-clinical ulnar artery occlusion, diagnosed by a combination of Allen's test and arteriography.

Whilst HSS is stated to occur in the dominant hand, care is needed to define the hand used preferentially for hammering, which may not be the dominant hand. The Kaji series [8] showed that the right hand was involved in 53% of cases, the left in 25% and both in 22%. Little and Ferguson [32] reported that 62% of 127 vehicle maintenance workers habitually used the hand as a hammer and 9% had HHS of one or both hands, with only two having bilateral disease. Bilateral disease was reported by Conn [1] in 2 of 13 patients.

### Diagnosis

The presentation of HHS may initially appear to be that of Raynaud's phenomenon. Initial exclusion of the other causes of Raynaud's phenomenon, such as scleroderma, systemic lupus, or rheumatoid disease must consider the possibility of late development of other manifestations. Occupational Raynaud's phenomenon is commonly attributed to hand–arm vibration exposure, with scleroderma also being reported as sometimes having an occupational basis. Assessment of occupational factors leading to Raynaud's phenomenon must include consideration of the factors distinguishing HHS from classic Raynaud's phenomenon, which were summarized by Spencer Green [5] (see Table 2).

Cantero [33] summarized the clinical features of HHS as being subcutaneous thickening, tenderness on compression and percussion of the hypothenar eminence or Raynaud's phenomenon of the last fingers. While pallor and cyanosis may appear, it is notable that hyperaemic redness has not been described [34]. A hypothenar mass or callus is frequently detectable in patients with HHS [35]. While Allen's test may be useful, Kaji et al. [8] found this to be negative in four (17%) of their cases. False-positive Allen's tests occur frequently if the wrist and fingers are hyperextended [36], although with the wrist and fingers in slight flexion the test accurately predicts the continuity of the palmar arch as assessed by Doppler ultrasound. Interindividual variations in the arterial supply of the affected hand influence the clinical symptomatology, with possible masking of arterial occlusions [42]. Painful finger clubbing has been reported in association with a palmar aneurysm, the pain disappearing after resection and arterial reconstruction [37]. Doppler examination may be useful. Taute et al. [38] found that colour-coded duplex sonography (CCDS) enabled distinction between HHS and other causes of digital ischaemia.

Arteriography is the gold-standard test, which will differentiate HHS from other vascular abnormalities in the hand [39], but Ferris et al. [9] showed the presence of the typical 'corkscrew' segment in the asymptomatic hand of patients with contralateral HHS. The corkscrew sign is the radiological demonstration of alternating areas of stenosis and ectasia, characteristic of fibromuscular dysplasia [10].

### Hand–arm vibration exposure

Three of the papers reviewed attributed HHS to vibration exposure. Noel et al. [40] reported the case of a man with 25 years exposure to vibration as a driver of a heavy earth-moving tractor. Kaji et al. [8] reported 24 cases of HHS among 330 vibration-exposed workers. Lee and Evans [41] reported a single case from Canada, described as vibration-induced white finger, but with a positive Allen's test and arteriographically confirmed absence of the superficial palmar arch. They concluded that the change in vascular supply to the hand resulted from repetitive blunt trauma to the hand. The nature of the work undertaken by the subjects of each of these papers is such that any effect of hand–arm vibration cannot be distinguished from the effects of either single or multiple hypothenar traumas.

It is an understandable concept that repeated trauma over the hypothenar eminence may result from gripping a piece of equipment that is intrinsically associated with vibration. The classical presentation of the vascular component of hand–arm vibration syndrome is of Raynaud's phenomenon initially affecting the tips of those digits with greatest hand–arm vibration exposure and subsequently spreading along those digits and to adjacent digits. For workers using tools such as pneumatic road drills, this will result in a pattern of episodic blanching affecting the little finger most, with the other fingers affected less the more lateral they are.

The anatomy of the superficial palmar arch is variable, but typically is supplied by the ulnar artery and supplies...
the digital arterial supply to the medial three fingers. It is therefore highly likely that compromise of the ulnar arterial blood supply will result in a pattern of Raynaud’s phenomenon, or Raynaud’s-like symptoms affecting those digits classically associated with use of pneumatic road drills. However, the absence of typical hyperaemic flush in HHS may be a useful distinguishing feature, along with a history of more widespread colour and temperature changes and a positive Allen’s test.

While logic dictates that the pattern of symptoms resulting from hand–arm vibration exposure must follow the pattern of such exposure, consideration of the possibility of HHS is essential to the assessment of such cases, either as an alternative or contributory cause of symptoms initially attributable to vibration-induced disease.

Management

Since tobacco may be a predisposing or aggravating factor [42], cessation of smoking is recommended. Treatment options are conservative or reconstructive, with exclusion of the embologenous area [43]. Conservative measures including intravenous heparin and prostaglandin E1 may be useful, with control of risk factors by smoking cessation, low-lipid diet and repeated venesection to reduce polycythaemia [44]. Generally, HHS is diagnosed too late for recanalization to be a viable option [45], although resection followed by interposition vein graft with functional recovery has been reported [46], with 84% patency of arterial repairs at 2 years [9].

Graft occlusions have occurred in those who were unable to stop smoking [47]. Ligation of the ulnar artery will result in elimination of blood flow to an aneurysm and thereby prevent further embolization [48]. Amputative debridement may be required. Cervical sympathectomy [49], stellate ganglion blockade and thrombolysis [50–52] have been suggested. However, the first priority must be the avoidance of further traumatic insult.

While the history of hypothenar trauma may be clear and separate from confounding factors, health professionals should be aware of the possibility of HHS causing symptoms that may mimic those of classical hand–arm vibration syndrome.

References

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