The Impact of Copper Inserts in Relieving Joint Pain

By

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Introduction

Arthritis is the biggest cause of disability in the UK affecting people of all ages. More than 7 million adults in the UK (15% of the population) have long term health problems due to arthritis and related conditions and nearly 20% (9 million) of the UK population have visited their GP in the last year with arthritis and related joint conditions. The number of people in the UK with osteoarthritis appears to have risen over the past 10 years and more people are seeking help from their GP. It is estimated that at least 4.4 million people have x-ray evidence of moderate to severe osteoarthritis in their hands with just over 0.5 million with moderate to severe osteoarthritis in their knees and 200,000 having moderate or severe osteoarthritis in their hips. With the increase in obesity it is projected that these numbers will increase dramatically. Rheumatoid arthritis affects a further 380,000 people in the UK with around 12,000 new cases a year. The Arthritis Research Council (ARC) estimates that 206 million working days were lost in the UK in 2000 because of arthritis, equivalent to a loss of production of £18bn with a cost of prescriptions for arthritic drugs amounting to £341m annually. The cost of hip and knee replacement surgery for osteoarthritis costs another £400m annually.

The management of arthritic joint and muscle pain can be challenging as standard treatments may have significant side effects and are not curative (Dieppe and Lohmander 2005). Drug therapy for osteoarthritis can range from simple analgesics to non steroidal anti-inflammatory agents (NSAID - non-selective and Cox2 selective). Intra-articular steroids and intra-articular hyaluronan are also used before resorting to surgery. In the management of rheumatoid arthritis similar medications to those used for osteoarthritis are employed as well as other disease-modifying anti-rheumatic drugs (DMARDs) that have potentially severe side effects.

Because the management of arthritic joint and muscle pain can be difficult, many of the sufferers have turned to alternative and complementary therapies and in 5 major studies over the last 10 years approximately 30-60% of sufferers have resorted to these therapies (Resch et al 1997). Most notable have been chiropractic, acupuncture, homeopathy, relaxation techniques and herbal remedies. Glucosamine with or without chondroitin has been extremely popular and shown to be effective in mild to moderate conditions.

The use of metallic devices such as magnets and copper bracelets has also been made for the alleviation of joint pain in the belief that copper is absorbed through the skin and affects copper dependent enzymes in joints thereby reducing inflammation. Copper absorption theories are still not validated. However there is some epidemiological evidence that copper miners in Europe had a lower than expected rate of arthritis (Dollwet et al 1985) . With that in mind it had been observed that a number of sufferers of both rheumatoid and osteoarthritis used copper in various forms with seemingly beneficial results in alleviation and moderation of pain. The amount of copper absorbed from devices such as bracelets is considered to be minimal and other proposed mechanisms of action include bio-electrical changes due to the proximity of the device to the effected joint.

A new copper device ("Copper Heeler"*) which is a copper inner sole (Fig.1) placed under the heel within a shoe, has been developed. This device was developed in the assumption that the increased area of contact with the thickened skin of the heel would be more effective than a bracelet and therefore deliver greater copper treatment effect. The purchasers of this product were thereafter noted to report large improvements in the arthritic symptoms. This pattern prompted further investigation of this effect by undertaking a retrospective questionnaire-based (non-validated) study. This observational study provided pilot data to examine the impact of wearing a copper insert on joint discomfort.

*Orthotics-online, 12 New Cavendish Street, London, W1G 8UN (www.orthotics-online.co.uk)

Material and Methods

A questionnaire study was sent out 4 weeks after 230 unselected sufferers of joint discomfort and muscle pain had purchased a “Copper Heeler“ device. They were instructed as to its usage in that it had to be inserted between the sock and the shoe. The “Copper Heeler” is a piece of pure copper moulded to the shape of the foot which comes in four sizes and weighs between 65-164g per pair and comes with an adhesive pad to place inside the shoe. The thickness of the insert varies between 0.7-1.0mm. Within 2 months 150 of the questionnaires had been returned and were analysed; a further 45 were received after the close of the study.

Questionnaire Design

The questionnaire was designed to ascertain certain facts both general and specific, and information about the wearer of the “Copper Heeler”. The type of pain, its duration and severity was assessed. The severity of joint pain was measured using a 1-5 scale with 1 & 2 equivalent to mild, 3 corresponding to moderate and 4 & 5 as severe forms of pain. The absolute figures were converted to percentages for ease of comparison. They were also asked about the type and usage of medications.

In assessing the efficacy of the device, the length of usage and specifically what improvement the device had on the alleviation of joint pain and when any improvement first appeared was noted. This was measured on an analogue scale of 1-5 with 1 being no improvement and 5 being a vast improvement in symptoms. The comfort of the device was also assessed.
A section for any further comments was included and the majority of respondents obliged.

Results

Population characteristics

150 persons of whom 45 were male (30%) and 88 female (58.7%) with 17 (11.3%) in whom the sex was not known, completed the questionnaire. The mean age was 60.6 years (95% confidence interval was 56.7-64.2) with a standard deviation of 22.3 and a median age of 65.

From Table 1 it can be seen that the time that the symptoms had been evident was more than 5 years in the majority of cases (54%).

Severity of Symptoms

The severity was assessed according to the analogue 1-5 scale. It can be seen from Table 2 that the majority of the group featured in the severe category.

Duration of Usage

Table 3 shows the duration of usage and it can be seen that the majority (58%) wore the device for more than 4 weeks.

Improvement in Symptoms

Table 4 shows the percentage improvement and at what stage (in weeks) a positive change was first noted. Those who had worn the device for more than 4 weeks had the best percentage improvement. Just under one half noted an effect as early as 2 weeks. When percentage improvement was assessed against the original severity of symptoms (Table 5) it was seen that those with mild symptoms noted a 55% improvement whereas those with moderate symptoms had a 70% improvement and those with severe disease had a 63% improvement. The mean improvement was 62.4% for men and 65.2% for women, the standard deviation being 22.2% and 24.5% respectively. Only 4% of the respondents had no improvement. When the duration of usage versus percentage improvement was analysed (Table 5) it was evident that within 3 weeks 24 (16%) of the group already had a 59% improvement whereas the 87 (58%) who had worn it for more than 4 weeks had a 66% improvement.

Effect on Medication

In Table 6 it can be seen that 107 (72%) of the responders used medication whereas 41 (27%) did not and 1% did not answer. Forty-nine (46%) of them noted a 50% or more reduction in medication when wearing the device.

General Comments

Very subjective comments were analysed as to if the device was good, bad or neutral. One hundred respondents answered this question, 74 of them making favourable comments compared to only 5 who made a negative comment. The remainder had a 'neutral' comment.

Level of Comfort

The overwhelming majority (95%) found that they were either comfortable or indeed forgot they were wearing the device.

Discussion

Of the 230 questionnaires given out 195 were returned. The study population was confined to the first 150 who replied within 2 months of having purchased the device.

The overall improvement was 96% with only 3 individuals confirming no improvement. Possible sources of bias could be derived from the number of non-responders and that the questionnaire was not validated. It could be argued that non-responders may not have been helped and therefore did not feel impelled to reply. However, in responders, improvement seems to have occurred very early after initial insertion of the device and already at 3 weeks nearly 60% of the respondents had some improvement. When the improvement was related to severity of symptoms it was seen that there was a 55% improvement amongst the small number with mild symptoms but for those with moderate symptoms who comprised 36% of the population there was a 70% improvement and for the remainder who comprised half of the population there was a 63% overall improvement. Probably the most important aspect of the results was the fact that in those respondents who had used medication (107/150) there was a 50% or more reduction in medication usage in 46% of them.

The question has to be asked as to how a relatively simple device is exerting such a significant influence. The use of copper has been employed in treating musculo-skeletal disease since ancient times (Dollwet et al 1985). It was used to prevent infection of fresh wounds using a dry powder mixture of what would seem to have been copper oxide and copper sulphate, in ancient

Egypt. In later times the use of copper wrist and armbands has been a popular treatment for arthritis. Luton, the French physician, in 1885 reported using copper acetate to treat arthritic patients with an external salve of hog's lard and 30% neutral copper acetate. He also used pills of 10 mg of copper acetate for internal treatment (Dollwet et al 1985).

Could small amounts of the copper from the device indeed be absorbed and exert a systemic effect, which was therapeutic? However the mechanism of copper in such a role is unclear. It has been well documented that copper serum levels are elevated threefold during inflammatory conditions but during remission the copper levels seem to return to normal. However this response can be confusing as the body normally mobilises tissue stores of copper as a therapeutic response. The redistribution of copper in the body may have a general role in responding to disease or interrelated stress. Although raised copper levels have been implicated in disease causation it may be that there is a natural synthesis of copper-dependent regulatory proteins and enzymes required for the bio-chemical responses to stress.

Metals such as copper are essential elements. Such metals are used in diverse physiological mechanisms such as storage, transportation, and regulation of cellular metabolism. These essential elements are utilised in the form of organic-complexes with proteins and enzymes. The effective use of copper-based pharmaceuticals may therefore not be mediated by its inorganic compound state, but rather utilised via its metallo-organic complexes or chelates. Sorenson et al (1966) found that copper complexes in non-toxic doses have therapeutic efficacy in the treatment of inflammatory diseases. Various copper metallo-organic complexes have been investigated in the treatment of human patients with arthritis and chronic degenerative diseases. Also copper complexes have been formulated with non-steroidal anti-inflammatory agents such as salicylic acid, aspirin and ibuprofen and found to have greater efficacy than their parent compounds. Copper salicylate may also have a better anti-inflammatory effect than cortisone without its side effects.

Walker et al (1981) compared topical application to orally ingested analgesic and anti-inflammatory drugs and found that the former, present in copper bracelets was highly effective. However a recent study (Finegold 1999) showed that copper bracelets for rheumatism were no better than a placebo for the alleviation of pain (Finegold & Flamm 2006). However the authors say that "whether the effect is due to magnetic forces or placebo it remains real and impressive and similar to that found using conventional anti-inflammatories and creams". Walker et al (1981) found that the bracelets were effective and felt that the components of the sweat and the solubility of copper in the sweat accounted for copper levels in sweat in keeping with probable absorption. They showed that a pair of copper bracelets lost 80mg of copper in 50 days when worn around the ankles and around the wrist lost 90mg in that time. However it would be hard to imagine any significant absorption of copper from the "Copper Heeler" through the sole considering the thickness of the skin overlying the sole of the foot.

Therefore it may be that there is a therapeutic electrical effect from topical copper appliances. Copper has a high electrical conductivity. Dissimilar metals within an acidic environment as found in sweat generate differential electrical potential through electron transfer. This battery principle may be relevant with layered bracelets or with appliances that contain copper when they react with other metals such as are present in human sweat when it acts on these metals. Although this may generate a tiny current there could be other unexpected surface influences that are induced. It could be speculated that the primary afferent nerve fibres (type A-delta and C) warrant further studies, as an anti-inflammatory effect of copper chelates may influence these nerve types. There could also be interference and an influence on the thick myelinated A-beta nerve fibres, which do not generally register pain unless sensitised by inflammation (Schaible 2007). Noxious sensation is also registered through nociceptors (as free nerve endings) of thin myelinated A-delta and unmyelinated C-nerve fibres (Besson 1997). Local anti-inflammatory agents, local anaesthetics and electrical modulation preferably block the thin fibres and nociceptors thereby producing their analgesic effect (Sorenson 1982). Copper chelates may have such an anti-inflammatory

effect at such sites (Sorenson 1976). The question still remains unanswered as to how the copper in the device is exerting its beneficial effect.

This retrospective study did not use validated tool and therefore is not as robust a prospective study. Nor were we able to exclude non-responder bias. However It was an important observational study aimed at gathering pilot data which assessed the impact of wearing copper inserts and their effect on joint discomfort. The improvement of 60% in all grades of severity would indicate that a randomised placebo controlled trial should be undertaken. The construction of a placebo insert is underway (personal communications) but the choice of a satisfactory constituent will be a problem as the use of other metals in such a device may have co-founding effect. Despite the limitations of this study this simple low cost device with no obvious side effects and a 60% reduction in symptoms seems a promising therapeutic modality. The data presented in this paper certainly warrants further investigation with more robust research methods.

Tables

TABLE 1

Length of Symptoms		
Years	***n* =**	**%**
> 5	82	54.7
2 -- 5	55	36.7
< 1	12	8.0
Not Known	1	0.6

TABLE 2

Severity of Symptoms (1-5 analogue scale)			
Severity		***n* =**	**%**
1 -- 2	Mild	22	14.7
3	Moderate	36	24.0
4 -- 5	Severe	89	59.3
Not Known		3	2.0

TABLE 3

Duration of Usage		
Weeks	***n* =**	**%**
2	9	6.0
3	24	16.0
4	28	18.7
> 4	87	58.0
Not Known	2	1.3

TABLE 4

% Improvement (1-5 analogue scale as a %) versus time at which first positive change evident	
Weeks	**% Improvement**
2	48.9
3	59.2
4	56.4
> 4	66.2

TABLE 5

% Improvement (1-5 analogue scale as a % versus severity of symptoms)		
Degree of Severity	***n* =**	**%**
Mild	22	55.0
Moderate	36	70.0
Severe	89	63.4
Not Known	3	-

TABLE 6

% Reduction in Medication (*n*=107 used Medication)		
% Reduction	***n* =**	**%**
25	4	3.7
50	23	21.5
75	16	15.0
100	10	9.3
Sub total	**53**	**49.5**
No change	54	50.5
Total	**107**	**100.0**

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Conflict of interest

none

Figure 1: The “Copper Heeler” and its positioning in the shoe