Alteration of needle tips with dry needling techniques

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KEYWORDS
Bone;
Insertions;
Microanalysis;
Muscle;
Skin;
Solid needle

Abstract

Introduction: Dry needling is a technique that consists of piercing the skin with a solid needle and destroying an area of myofascial trigger points. The different types of needles and their manipulation are factors worth considering for the selection of the needle and its application.

Aims: To evaluate the possible modifications of needle tips due to their clinical use during dry needling.

Material and methods: Three types of needles were analysed: 0.25 mm and 0.32 mm (AguPunt®) and 0.25 mm (SEIRIN®) in diameter and two scanning electron microscope devices (FEI Quanta 600 and JEOL JSM 6360LV) at a magnification of 2,000 diameters. The following situations were evaluated: unused new needles; needles manipulated without gloves; the effects of 10 to 40 muscle insertions; and after 2 to 10 bone hits. Occasionally, dispersive X-ray microanalysis was performed using an Oxford Instruments, Inca device.

Results: The new needles displayed metallic particles on the surface; numerous dust particles were found adhered to the surface of needles manipulated without gloves; no alterations were found in the morphology of the needles, neither after 10 or 40 muscle insertions. After hitting the scapula (2 and 10 hits) the tip of some needles displayed alterations, depending on the operator. The microanalysis examination of needles showed that both brands had similar compositions.

Conclusions: This study did not find any important defects in the evaluated needles, neither before nor after their clinical use with dry needling techniques.

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Introduction

Myofascial pain syndrome (MPS) is a collection of sensory, motor and autonomic symptoms caused by myofascial trigger points (MTrPs)\(^1,2\). A MTrP is a hyperirritable spot in a skeletal muscle associated with a palpable and sensitive nodule located within a taut muscle band. This taut band consists of a group of muscle fibres with a greater consistency and an abnormal state of tension. MTrPs are very common in human beings and it is estimated that almost everybody may suffer at least one episode of the same during their lifetime\(^3\).

Regarding the treatment of MTrPs, this may be administered either by conservative or invasive means\(^2\). Invasive treatment consists of the introduction of a needle in order to reach the MTrP with the aim of destroying the same. This treatment is called “dry needling” (DN), in reference to the fact that no substance is injected. Dry needling is the treatment consists of the introduction of a needle in order to reach the MTrP with the aim of destroying the same. This treatment is called “dry needling” (DN), in reference to the fact that no substance is injected. Dry needling is the treatment that presents the best results and should be the treatment of choice whenever possible\(^4\). Steinbrocker\(^5\) was the first to describe the benefits of needling treatments for the control of pain. Thereafter, many studies have followed by authors such as Travel and Simons, who have described the dry needling application technique in depth\(^2\).

Initially, the needles that were used to perform the dry needling technique in MTrPs were hollow needles. Subsequently these have been replaced by solid needles, which are similar to those used in acupuncture. These needles originated in 1977 in the West Midlands, United Kingdom\(^6\). In the past, acupuncturists performed their interventions with reusable and sterilisable needles, however after a hepatitis B outbreak, the UK Ministry of Health recommended the use of disposable single-use needles, in order to avoid contamination. In 1978, the first disposable acupuncture needle was manufactured, however as initial productions were very costly, China decided to take up the challenge of reducing costs by combining automatization with low production costs\(^7\).

At present, the use of disposable needles has extended throughout the world, as many trademarks manufacture these at an affordable cost. This reduction in production costs may have put the quality of needles at risk, which is the reason why Hayhoe et al.\(^7\) studied three brands of the most commonly used needles using scanning electron microscope (SEM) techniques. These authors discovered that no needle is perfect and, furthermore, many have considerable defects, including some considered entirely reliable and safe. Thereafter, Xie et al.\(^8\) used SEM to analyse two needles from the best known brands on the market, performing interventions on a model made of gel that simulated human tissue from the “UNICO Needling Practice Kit” brand, commonly used by acupuncture students. They observed that there were significant differences in the finish of the needles, with one of the brands showing irregularities in its coating or even deformities at the tips. Furthermore, some needles had foreign bodies that disappeared after needling yet which stayed in the gel model at the intervention site.

The main aim of the current study was to assess the state of the needle tip of two commonly used brands in physiotherapy in different situations: prior to its use; piercing the skin; intramuscular interventions, and hitting the bone; as these are situations that commonly occur during the perfor-
mance of dry needling techniques. Furthermore, the sec-
ondary aims were to determine the chemical composition of
the needles of both brands and to evaluate possible differ-
ences, as well as assess the state of the needle tip in situa-
tions of poor praxis, such as reintroduction of the needle
into the guide tube using the needle tip.

Material and methods

Volunteers

The authors of this study volunteered for the different types
of needling interventions. This study was performed by two
groups (see below), during which a volunteer from each
team was subjected to the different types of needling
(males aged 24 and 25 years).

Needles

Three types of needles were used of two qualities and brands
(pre-packaged, sterile and single-use needles): two needle
diameters of the AguPunt® brand, promoted for dry needling,
and extensively used in Spain (of 0.25 mm and 0.32 mm diam-
eter and 25 mm and 40 mm length, respectively); one type of
needle of the SEIRIN® brand, initially promoted for acupunc-
ture, but, due to its resistance and quality (tips finished with
laser and surpassing three levels of quality control), many
physiotherapists currently use this type of needle to perform
dry needling techniques (0.25 mm diameter and 25 mm long).

In order to examine the surface of the needle tip, a total
of 68 needles were indiscriminately selected from different
batches of the commercial product.

Scanning electron microscope

The needle tips were studied using two SEM devices: FEI
Quanta 600 from the Scientific Technical Service of the Ro-
vira i Virgili University and JEOL JSM 6360LV from the Sci-
cientific Technical Service of the Miguel Hernandez University.
The magnification of the work was 2,000X, occasionally
110X magnification was also used. Also, on occasion, disper-
sive X-ray microanalysis was performed with an Oxford In-
struments, inca, associated with a FEI Quanta 600 scanning
electron microscope.

Protocol/Procedure

The needle tips were assessed in the following situations:

• Unused new needles and manipulated both with, and
  without, gloves.
• Repeated skin insertions over the infraspinatus region of
  the scapula. The tip of each needle was assessed before,
  and after, 2, 4, 6, 8 and 10 skin insertions.
• Repeated intramuscular punctures in the infraspinatus
  muscle. The tip of each needle was assessed before, and
  after, a single skin insertion; thereafter the tips were as-
  sessed for every 10 insertions for up to 40 insertions.
• Bone hits. The tip of each needle was assessed after hit-
  ting the dorsal aspect of the scapula in 2 and 10 obvious
  impacts using moderate force.

Additionally, and prior to each use, a microanalysis of
some new needles was performed in order to observe the
possible existence of impurities on the surface.

These procedures were performed independently by two
groups: one at the Miguel Hernández University (Elche,
Spain) and another at Rovira i Virgili University (Tarragona,
Spain). All the physiotherapists practicing the needling were
experts in “conservative and invasive physiotherapy for
myofascial pain syndrome (MPS)” and had received training
from the seminar series “Seminarios Travell & Simons”.

Statistical analysis

SPSS v17.0© statistical software was used to analyse the re-
sults. The values were expressed as the mean ± SD. When
the differences between the two groups were evaluated,
the student’s t-test was used. The differences were consid-
ered significant at P< 0.05.

Results

Unused needles

Figure 1.A displays an example of needle tips immediately
after being unpackaged. Needles were manipulated with la-
tex gloves, as performed in clinical practice. Several irregu-
larities are observed on the surface. This is a common
finding in AguPunt® needles, and only very occasionally ob-
erved in SEIRIN® needles. Microdialysis sampling of these
irregularities was performed which revealed that these
were metallic particles with similar composition to that of
the needle, and therefore possibly remainders of smelting.

Figure 1.A displays the microanalysis of any area of the nee-
dle (left) compared with a randomly selected impurity
(right).

Furthermore, we were interested in learning the conse-
quences of manipulating needles without gloves (i.e. with
bare hands). Figure 1.B shows the presence of aggregated
particles along the entire needle length, probably due to
electrostatic charge, especially shedded skin cells, as mi-
croanalysis determined that this was skin (fig. 1.B, below).

Based on poor practice habits, we evaluated several new
needle tips after these were reintroduced into the guide
tubes using the tip of the same, rather than the handle. In
some cases, this was performed very carefully (see example
in fig. 1.C, left) while, in other cases, and without due care,
this altered the morphology of the tip (see example in
fig. 1.C, right).

Skin insertions

The tips of 10 needles were evaluated before and after 2, 4,
6, 8 and 10 skin insertions upon the dorsal area over the in-
fraspinatus muscle. For this purpose, we used the guide
tubes that come in the packaging with the needles. In order
to reuse the needles, these were reinserted into the guide
tubes via the handle, thus protecting the tips. Figure 2 dis-
plays examples; the AguPunt® needles seem to be the most
altered. Apparently, the surface degrades from the second
insertion until the fourth (fig. 2.C) and progressively im-
proves until the 10th (fig. 2.D). It is surprising that at the
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Figure 1  New needles. A. Example of an unused needle manipulated with gloves. Lower left: microanalysis of a randomly selected needle area. Lower right: microanalysis of an impurity. Observe that the chemical components are similar. B. Example of an unused needle manipulated with bare hands. Multiple adhered impurities are visible. Below, microanalysis of a sample of skin impurity. Besides the chemical components on the needle surface where it is resting, there is abundant silicon and, as the form of the impurity is amorphous, this is indicative of skin cell shedding. C. Two examples of needle tips reinserted into the guide tube via the needle tip. According to the level of care exercised by the user, the tips may become more or less altered.
Figure 2 Skin insertions. Repeated insertions were performed until the level of the dermis at the dorsal area over the infraspinatus muscle. Example of the tip of the AguPunt® needles (A-D) and SEIRIN® (F-I) before (A, F) and after 2 (B, G), 4 (C, H) and 10 (D, I) skin insertions. Furthermore, AguPunt® needles of a greater diameter were analysed with a single insertion, however penetrating up to 1 cm (J).
tenth skin insertion the appearance of the tip is almost as sound as before its use. The tips of the SEIRIN® needles appear to resist better to skin insertions. In addition, deeper insertions were performed of up to 1 cm, obtaining similar images (fig. 2.J). Frequently, shedded skin was found adhered to the tips, as observed in figures 2.C and 2.H (see also figs. 3.H, 3.I and 4.B). The results, obtained by the two experimental groups (Miguel Hernandez University and Rovira i Virgili University), were similar.

**Muscle needling**

The needle tips were evaluated after a single skin insertion and after up to 40 rapid muscle insertions in the infraspinatus muscle. The tips were evaluated every 10 insertions. In the examples displayed in figure 3, the needle tips remained practically unaltered. Larger calibre needles were also evaluated in case the initial diameter could influence these results. Needles were only evaluated after 20 rapid muscle insertions. The example in figure 3.1 shows how the needle also remains unaltered after this test. The results obtained by both experimental groups (Elche and Tarragona) were similar.

**Bone hits**

The needle tip was evaluated before and after 2 and 10 clear and “moderately strong” impacts onto the scapula. As observed in the examples of figure 4, the needle tips mostly remained unaltered. As mentioned previously, there were many experiments performed in parallel by the two groups (University Miguel Hernandez and University Rovira i Virgili). One experimenter managed to substantially alter the tips with 10 impacts (fig. 4.E).

**Composition of needles**

After observing the similar performances displayed by both needle qualities, we evaluated their composition. This was quite similar, as displayed in table 1. Surprisingly, none of the two contained molybdenum. This element was actively and repeatedly sought, however we failed to find it in any of the needles under study.

**Discussion**

All newly unpacked AguPunt® needles commonly presented a series of impurities on the surface. Microanalysis inspection confirmed that these represented metallic elements from the smelting. This is not a new finding. In 2002, Hayhoe et al. measured three brands of acupuncture needles manufactured in China, in Japan and in the USA, using SEM. The images showed that all needles presented particles adhered to their surface. These authors did not analyse the composition of such particles. More recently Xie et al. assessed two of the most used brands on the market, one from China, another from Japan, using SEM. These authors randomly selected needles of each brand and performed interventions in a gel model used by acupuncture students as a model to simulate human tissue. These authors described that some needles had foreign bodies that disappeared after the insertion, and that these could remain within the tissue. In order to confirm this, they analysed the composition of the gel model in the intervened area and discovered that, in effect, there were remnants of metals apparent from the needles such as, for example, Cr, Fe and Ni. These results are identical to those found in the current study, what bears in mind that here this applies to dry needling needles.

The present study shows that if needles are manipulated without gloves, particles become attached along their full length, probably due to an electrostatic charge. Microanalysis determined that these particles are, in fact, one of the main components of domestic dust: shedded skin cells. Based on the previously commented study by Xie et al., we can infer that these organic particles may also end up within the patient’s tissues. We can thus conclude that the use of gloves, not only safeguards both the health professional and the patient, but also safeguards patients from the environment thus this is a further argument in support of the use of gloves.

Some physiotherapists reuse dry needling needles with the same patient and in more than one area. In order to do so, the needle is reinserted into the plastic guide tube before reusing. By doing so, not only can they alter the morphology of the needle, but also they may accidently suffer a needlestick injury with the associated risk of acquiring serious infections (hepatitis, HIV, etc.). In the present study we have determined that when the health professional is meticulous, the tips do not suffer, however, we believe it is necessary to remember that these types of needles are designed and manufactured for a single use (see below the discussion regarding the oiling of needles).

After just a few skin insertions, the AguPunt® needles presented a highly altered surface, with darker “geographical” images that surprisingly disappeared at the tenth insertion. The webpage of the AguPunt® brand describes using a triple oil coating to ensure that the needles penetrate better and are, therefore, less painful. We believe that it is precisely this oil that begins degrading, accumulating or leaving bare areas, which would explain these dark geographical images. Therefore, excessive skin insertions can lead to the needles penetrating less effectively and being more painful. Appar-

<table>
<thead>
<tr>
<th>Element</th>
<th>AguPunt®</th>
<th>SEIRIN®</th>
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<tbody>
<tr>
<td>Carbon (C)</td>
<td>07.66% ± 1.36</td>
<td>06.81% ± 0.51</td>
</tr>
<tr>
<td>Oxygen (O)</td>
<td>02.96% ± 0.63</td>
<td>05.60% ± 3.27</td>
</tr>
<tr>
<td>Aluminium (Al)</td>
<td>27.80% ± 6.80</td>
<td>35.61% ± 1.00</td>
</tr>
<tr>
<td>Silicon (Si)</td>
<td>01.60% ± 0.23</td>
<td>00.53% ± 0.01</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>13.71% ± 0.39</td>
<td>11.11% ± 0.61</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>01.06% ± 0.22</td>
<td>00.89% ± 0.24</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>45.36% ± 0.43</td>
<td>37.56% ± 2.70</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>04.58% ± 0.50</td>
<td>04.08% ± 0.33</td>
</tr>
</tbody>
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Microanalysis of the needles of both brands under study. Ten needles of each type were evaluated. None of these presented molybdenum. Data are expressed as % of weight ± SD. P > 0.05 (Students t-test) in all cases.
Figure 3  Muscle needling. Repeated fast muscle insertions were performed in the infraspinatus muscle with a single skin insertion. The tips of 0.25 mm needles were assessed every 10 insertions. A and B, 10 insertions; C and D, 20 insertions; E and F, 30 insertions; G and H, 40 insertions. We also evaluated needles with a greater calibre, 0.32 mm, just in case the initial diameter may affect the tips (I).
ment, the SEIRIN® tips are more resistant to skin insertions. The photos show that the tips of the SEIRIN® needles are far sharper than the curved AguPunt® needles and therefore perhaps for this reason they do not require special oiling (this aspect is not commented on in the commercial webpage). The lack of oil possibly avoids the “geographical” darker images that appear with the repeated insertions. In the related literature there are very few studies to demonstrate alterations of needles with use and, in general, these are related to acupuncture needles. In this sense, Langevin has performed multiple studies on the interaction of acupuncture needles on tissues. However, only in one does he tangentially assess the needle tips on the subcutaneous connective tissue, and he does not report great changes in stainless steel needles as described in the present study.

Multiple and fast muscle mass insertions with a single skin insertion hardly affected any of the needle tips examined. Also, all the needle tips remained unaltered after hitting the bone with 2 clear impacts of a “moderate strength” onto the scapula. Although 2 bone hits may be the most common number of impacts that occur when using a needle, and thinking of a possible abusive use of the same, we performed experiments with 10 hits. In this case, divergent results were obtained, depending on the experimenter. One group of experimenters did not obtain alterations of the tips whatsoever while another group managed to deform the tips. Besides the completely subjective concept of “moderate force” we wish to reinforce once more (the first mention of the same was regarding the reuse of needles) the importance of the appropriate training and experience of the health professional who practices the dry needling technique, more so even than the quality of the needles.

Nevertheless, the composition of both types of needles is quite similar and these do not contain molybdenum. Regarding the SEIRIN® needles, which were initially designed for acupuncture, and considering their shape and polish, they are understandably well suited to dry needling in which many insertions are required. Dry needling needles are composed of class I steel, type II, which is the so-called surgical steel. This variant of steel consists in an alloy that is rich in chromium (12-20%), molybdenum (3%) and, on occasions, nickel (8-12%). The idea of surgical steel for dry needling needles is explained by the fact that this material is more resistant for needling. Considering the resistance of the

Figure 4  Bone hits. The tip of each needle was assessed after hitting the scapula in 2 (A and B) and 10 (C, D and E) clear impacts with a moderate level of force.
needle tips obtained in this study, we can infer that molybdenum is not necessary in the steel alloy. As we commented previously, no studies have evaluated the tips of dry needling needles in their clinical use. However, many studies have evaluated the degradation of needles due to acupuncture. Not only do these needles have a generally different composition, but also they are not given a completely different use. For example, the acupuncture needles used in electroacupuncture present an aberrant degradation on the surface\textsuperscript{11,12} far from what can be obtained in dry needling.

In this study we failed to find defects in the needles evaluated neither before nor after their clinical use in dry needling. The differences in the shape of the tip and the needle polishing may facilitate less painful needling techniques, however this should be assessed in future studies. Alterations in the needle tips can only be found as a result of poor practice habits. On the other hand, the chemical composition of the needles reviewed is entirely similar, although these correspond to different brands. Our findings indicate that the performance of dry needling techniques using the needles that are commonly used in invasive physiotherapy does not represent a risk to patients' health.

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