



ORIGINAL

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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PALABRAS CLAVE

Agujas sólidas;
Hueso;
Inserciones;
Microanálisis;
Músculo;
Piel

Alteración de las puntas de las agujas por la técnica de punción seca**Resumen**

Introducción: La técnica de punción seca consiste en atravesar la piel con una aguja maciza y destruir un área de puntos gatillo miofasciales. Los diferentes tipos de agujas y su manipulación podrían ser un factor a tener en cuenta para la elección de la aguja y su aplicación.

Objetivos: Evaluar las posibles modificaciones de las puntas de agujas por su uso clínico durante la punción seca.

Material y métodos: Se analizaron tres tipos de agujas: de 0,25 mm y de 0,32 mm de grosor respectivamente (AguPunt®) y de 0,25 mm (SEIRIN®) con dos equipos de microscopía electrónica de barrido (FEI Quanta 600 y JEOL JSM 6360LV) a 2.000 aumentos. Se evaluaron en las siguientes situaciones: agujas nuevas sin utilizar; usadas sin guantes; de 10 a 40 inserciones sobre músculo; de 2 a 10 impactos sobre hueso. Ocasionalmente se realizó microanálisis por difusión de RX con un Oxford Instruments, Inca.

Resultados: Las agujas nuevas mostraron partículas metálicas en su superficie; en las agujas manipuladas sin guantes se adherían muchas partículas de polvo; no había alteraciones en la morfología de las agujas ni con 10 inserciones en piel ni con 40 inserciones en músculo; después de colisionar con la escápula (2 y 10 diez impactos) sólo se obtuvieron alteraciones en la punta de alguna aguja dependiendo del operador. El microanálisis de agujas evidenció que ambas tenían composiciones parecidas.

Conclusiones: En este estudio no se encontraron defectos importantes en las agujas evaluadas ni antes ni después de su uso clínico mediante la técnica de punción seca.

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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 lifetime³.

Regarding the treatment of MTrPs, this may be administered either by conservative or invasive means². 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 that presents the best results and should be the treatment of choice whenever possible⁴. Steinbrocker⁵ 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 depth².

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 Kingdom⁶. 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 contagion. 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 costs⁷.

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 secondary aims were to determine the chemical composition of the needles of both brands and to evaluate possible differences, as well as assess the state of the needle tip in situations 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 diameter and 25 mm and 40 mm length, respectively); one type of needle of the SEIRIN® brand, initially promoted for acupuncture, 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 Rovira i Virgili University and JEOL JSM 6360LV from the Scientific Technical Service of the Miguel Hernandez University. The magnification of the work was 2,000X, occasionally 110X magnification was also used. Also, on occasion, dispersive X-ray microanalysis was performed with an Oxford Instruments, 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 assessed for every 10 insertions for up to 40 insertions.
- Bone hits. The tip of each needle was assessed after hitting 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 results. The values were expressed as the mean \pm SD. When the differences between the two groups were evaluated, the student's t-test was used. The differences were considered 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 latex gloves, as performed in clinical practice. Several irregularities are observed on the surface. This is a common finding in AguPunt® needles, and only very occasionally observed 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 needle (left) compared with a randomly selected impurity (right).

Furthermore, we were interested in learning the consequences 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 shed skin cells, as microanalysis 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 infraspinatus 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 displays 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 improves until the 10th (fig. 2.D). It is surprising that at the

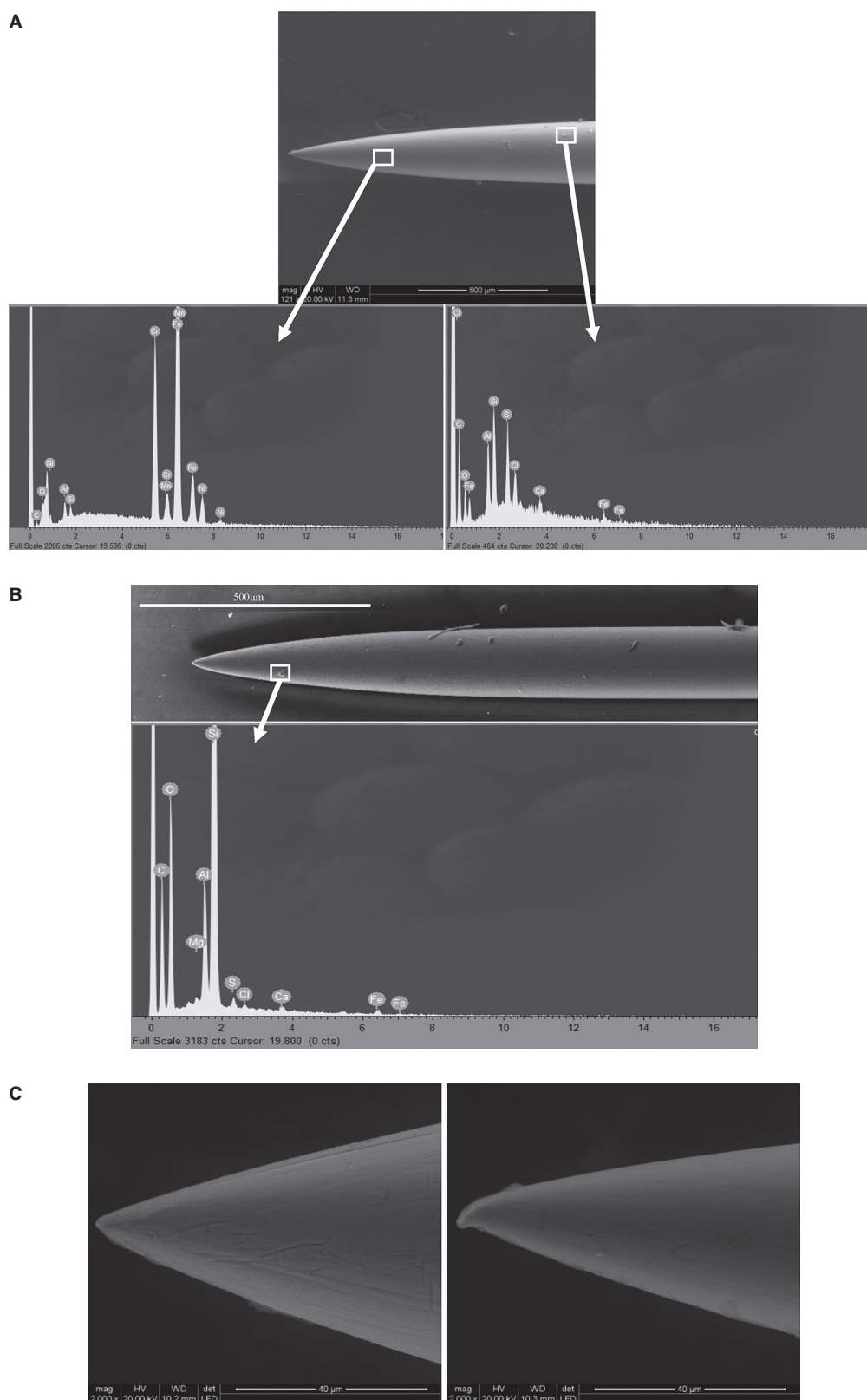


Figure 1 New needles. **A.** Example of an unused needle manipulated with gloves. Lower left: microanalysis of a randomly selected needle area. Lower right: microanalysis of an impurity. Observe that the chemical components are similar. **B.** Example of an unused needle manipulated with bare hands. 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.

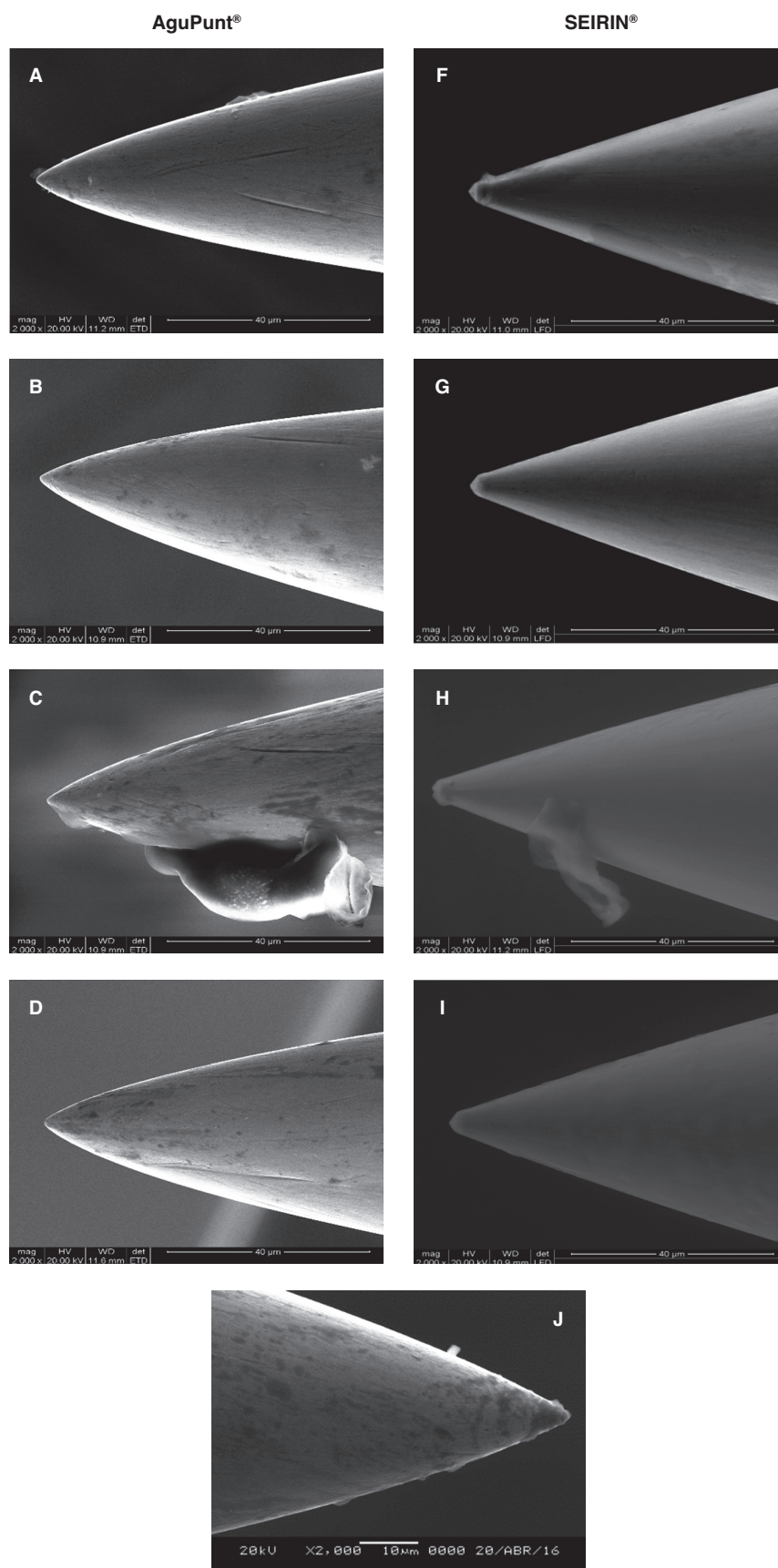


Figure 2 Skin insertions. Repeated insertions were performed until the level of the dermis at the dorsal area over the infraspinatus muscle. Example of the tip of the AguPunt® needles (A-D) and SEIRIN® (F-I) before (A, F) and after 2 (B, G), 4 (C, H) and 10 (D, I) skin insertions. Furthermore, AguPunt® 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.⁷ studied 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.⁸ 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 af-

Table 1 Needle composition

Element	AguPunt®	SEIRIN®
Carbon (C)	07.66% ± 1.36	06.81% ± 0.51
Oxygen (O)	02.96% ± 0.63	05.60% ± 3.27
Aluminium (Al)	27.80% ± 6.80	35.61% ± 1.00
Silicon (Si)	01.60% ± 0.23	00.53% ± 0.01
Chromium (Cr)	13.71% ± 0.39	11.11% ± 0.61
Manganese (Mn)	01.06% ± 0.22	00.89% ± 0.24
Iron (Fe)	45.36% ± 0.43	37.56% ± 2.70
Nickel (Ni)	04.58% ± 0.50	04.08% ± 0.33

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.

ter 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.⁸ 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 accidentally 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-

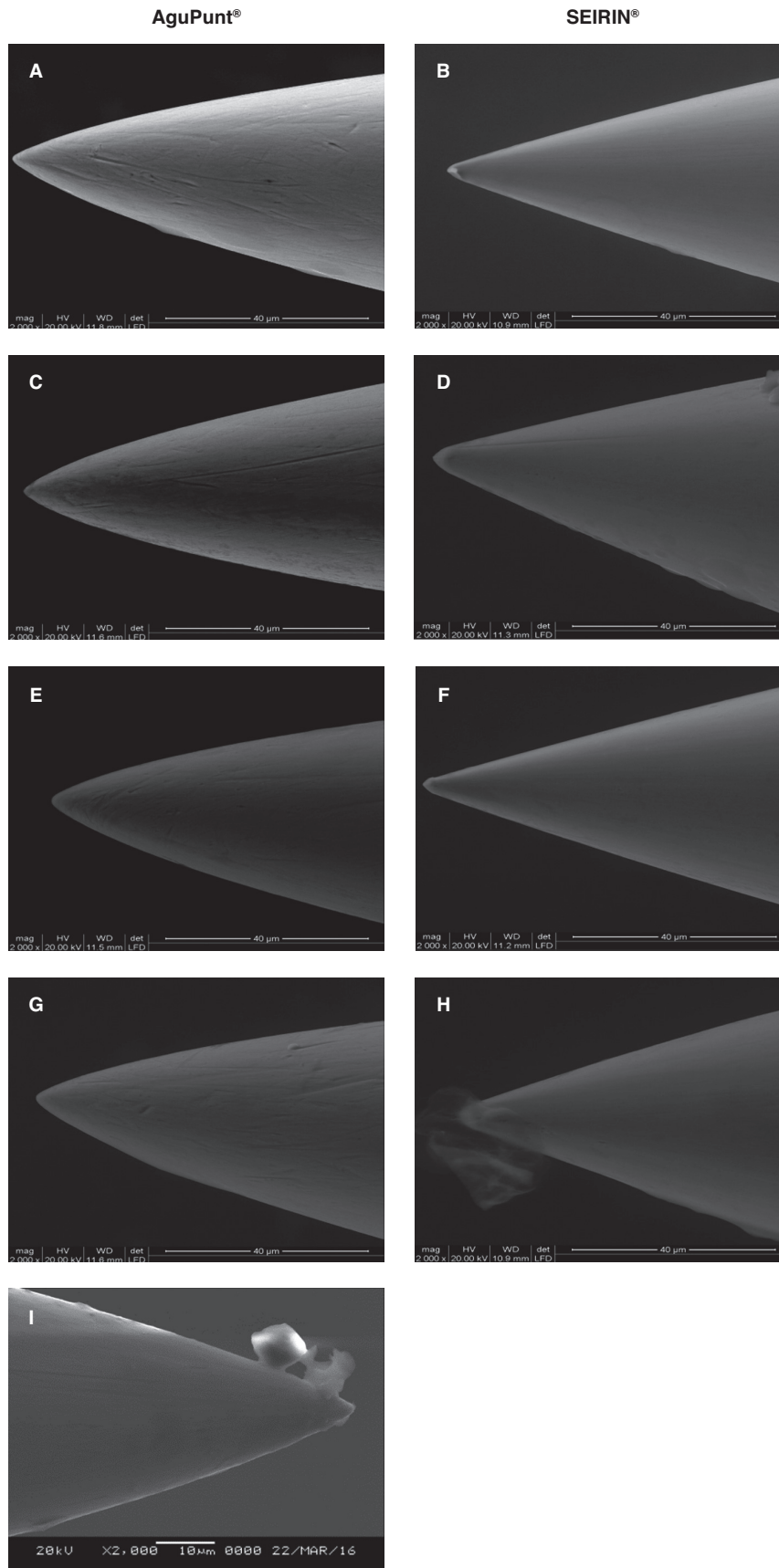


Figure 3 Muscle needling. Repeated fast muscle insertions were performed in the infraspinatus muscle with a single skin insertion. The tips of 0.25 mm needles were assessed every 10 insertions. A and B, 10 insertions; C and D, 20 insertions; E and F, 30 insertions; G and H, 40 insertions. We also evaluated needles with a greater calibre, 0.32 mm, just in case the initial diameter may affect the tips (I).

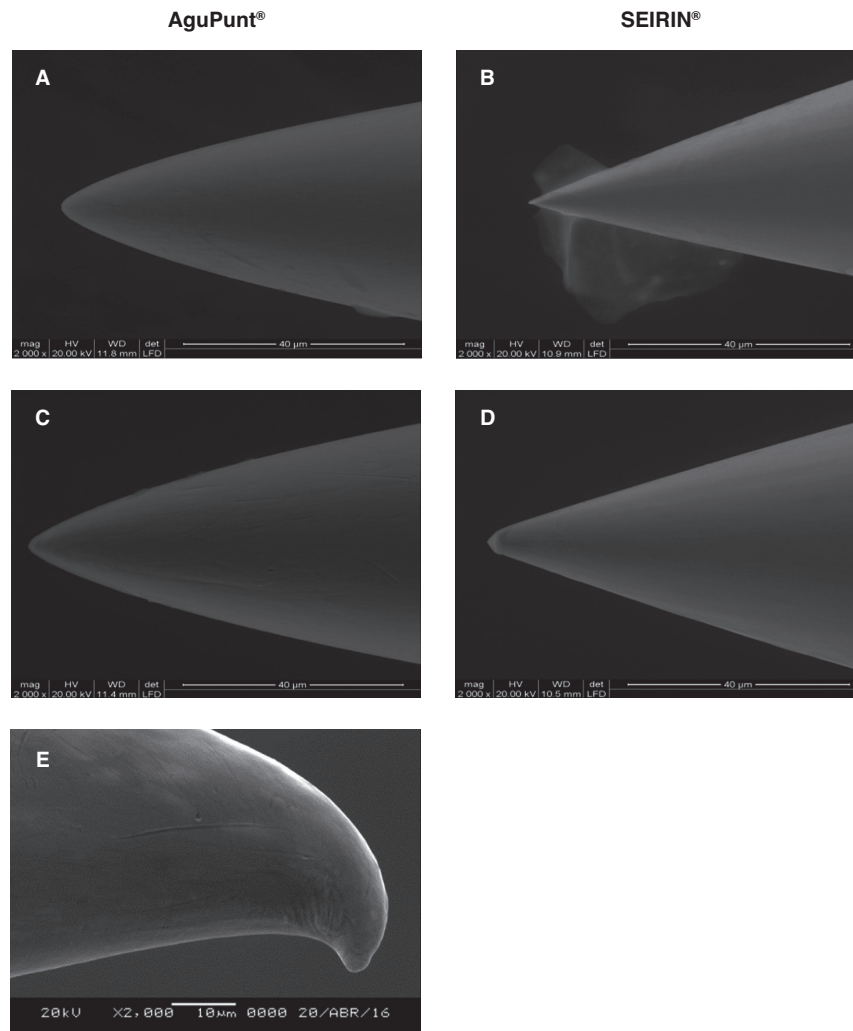


Figure 4 Bone hits. The tip of each needle was assessed after hitting the scapula in 2 (A and B) and 10 (C, D and E) clear impacts with a moderate level of force.

ently, 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 tissues⁹. However, only in one does he tangentially assess the needle tips on the subcutaneous connective tissue⁹, 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 per-

formed 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 steel¹⁰. 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

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^{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.

Acknowledgments

The authors wish to thank Dr. Mariana Stankova from the Service of Scientific and Technical Resources of the URV due to her incomparable technical advice regarding the assessments with the scanning electron microscope. We thank Orlando Mayoral for his valuable suggestions. This work is financed by a grant from the Carlos III Health Institute, Acción Estratégica en Salud (MMS, PI13/02084), Seminarios Travell & Simons®, and the Commission for Universities and Research in the Department of Innovation, Universities and Enterprise of the Generalitat de Catalunya (MB 2016 FI-B 00909).

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