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Scanning electron microscope morphological analysis of suture needle deformations after use in dentistry

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Abstract

Sutures are widely used in dental procedures, from simple extractions to complex surgeries like dental implant placements. The number of applied stitches varies with the size of the surgical wound, influenced by the thread length attached to the needle. Although needle tips are designed for optimal mechanical performance, their sharpening can lead to increased delicacy and susceptibility to deformation due to repeated contact with soft tissues. This study aims to perform a morphological analysis, using Scanning Electron Microscopy (SEM), to examine how the tips of suturing needles, differing in brand and morphology, are affected after multiple passes through soft tissues. We analyzed suture needles of two distinct morphologies from various manufacturers after use for 1 to 8 stitches on 192 patients. Deformations at the needle tips, measured along the axis and as protrusions from their profile, were proportional to the number of tissue penetrations, independent of the manufacturer. Tapered needles exhibited greater resistance to deformation. Our findings suggest that the tested suturing needles are effective for a limited number of tissue penetrations, indicating the need to restrict their use based on the number of stitches performed.

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Introduction

In dentistry, sutures are widely used on various occasions such as simple tooth extractions or during more complex surgical interventions such as the multiple insertion of dental implants.[1,2]

Suture needles are characterized by different parameters such as shape, length, diameter, section, type of tip and finally the thread which has different lengths.[3]

The needle shape can always be considered a portion of a circle which can be more or less complete so as to distinguish needles 1/2, 3/4, 3/8, and 5/8 of a circle. Regarding the length of the needle, the measurements range from 11 to 60 millimeters, although in dentistry the most used lengths range from 13 to 24 mm.

The needle thickness is consistent with the diameter of the thread in order to make the passage between the tissues at the metal-wire interface trauma-free.[4] In fact, the suture needle should not traumatize the soft tissues and for this reason it is defined as «atraumatic».[5,6] The needle sharp point should not tear the tissues but cut them precisely to allow the needle body to fit into the cut. The suture thread, that is connected to the needle, should pass secondarily through the same cut without irregularities that could create tears in the tissues (Figure 1).[7,8]

The section of the needle can be circular and in this case the needle is sharp only at the tip and the remaining part slides on the tissues without making further cuts; alternatively, the section can be triangular and the external part of the curvature can be sharp so when the needle is pushed between the tissues to be sutured, the blade continues to cut, widening the space in which the needle and secondarily the suture thread will slide. There are also needles in which the section is reversed compared to the previous ones; in fact the blade is on the inside of the curvature.

The needle tip can also have different shapes to facilitate the passage in the tissues, which can have a different consistency and therefore offer a different degree of resistance to the advancement of the needle itself. Thus, needles with a conical tip are distinguished, where the sharpening process has transformed the cylindrical tip of the needle into a pointed cone, which guarantees easy perforation of the tissues; this type of tip is typical of needles with a cylindrical section.

Another type of tip is the triangular one where a sharp three-sided pyramid represents the sharp part of the needle whose section is normally triangular and can be in all three versions: non-sharp, with external or internal cutting edge (Figure 1).

Finally, there is a further possibility of having a particularly sharp tip, on a cylindrical section needle, called taper-cut which combines the circular section of a suture needle with a sharp pyramid at the tip typical of triangular section needles.[9]

Surgical suture needles are produced using steel alloys to ensure adequate clinical performance which includes high ductility and strong resistance to twisting combined with considerable mechanical strength which allows the needle to be locked into the needle holder without slipping or deforming so as to allow precise and trauma-free sutures.[10-12]

The thread connected to the needle, which can be produced with different materials, absorbable or non-absorbable, allows multiple stitches to be placed based on its length and the type of suture used.

In this perspective, the needle tip is pushed against the soft tissues, overcoming their resistance and elasticity, which are crossed several times by the same needle until the suture is completed.[13-15]

To improve the smoothness of the needle, a silicone coating is often applied which allows easier penetration into the tissues, reducing trauma.[16]

Although the mechanical characteristics of the tip are accurate and suitable for the purpose, it is precisely the sharpening of the tip that makes this delicate area, sharp and thin, also deformable due to the repeated impact with the tissues that need to be sutured.[17]

Our study aims to evaluate, by a Scanning Electron Microscope (SEM), how the tip of different suture needles commonly used in dentistry changes depending on the number of times they pass through the soft tissues.

SEM provides high-resolution images that allow detailed observation of suture needle tip deformation providing information on their structural integrity. In detail, our study simulates a real clinical condition, in fact the dentist can suture the tissues, blocking them with a single stitch, passing the needle only twice through the tissues, but he may also have the need, as in major surgical interventions characterized by extensive surgical flaps, to suture with a large number of stitches; in this last case the same needle, especially if accompanied by a very long thread, is repeatedly pushed against the soft tissues, subjecting the sharpening of the tip to increasing mechanical stress with the risk of deforming it, progressively losing its initial characteristics. Unfortunately, the deformation of the tip of a suture needle could significantly reduce the atraumatic nature of this delicate surgical instrument which has the task of facilitating the healing processes of surgical wounds.[18] The presence of asperities risks creating lacerations on the tissues incised correctly, thanks to the sharpening of the scalpel, creating slowdowns in the healing processes with the appearance of inflammatory phenomena related to the greater traumatism of the delicate soft tissues present in the oral cavity. Evaluating how many times a suture needle is able to pass through soft tissues without deforming could avoid these clinical problems induced by incorrect use of a particular medical device such as a suture needle. By understanding the factors that contribute to suture needle deformation and selecting appropriate needle

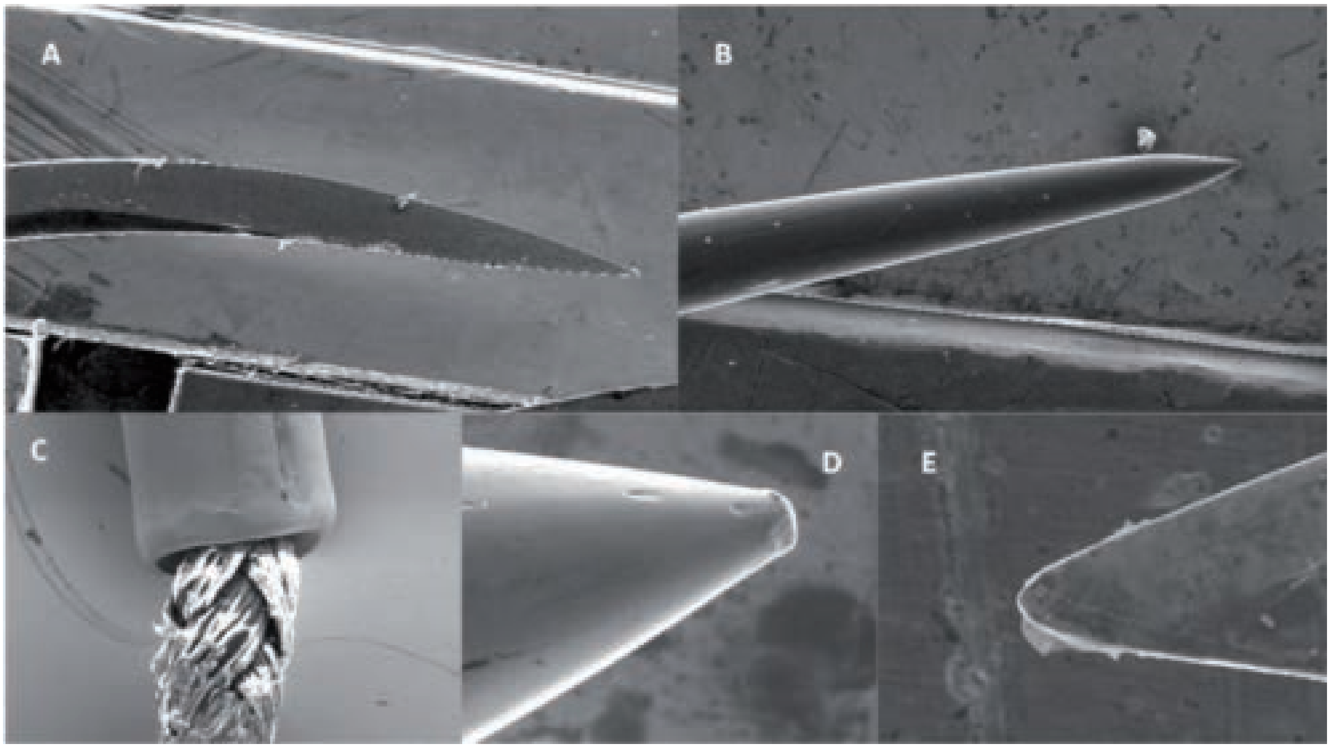

Figure 1. A) Scanning Electron Microscopy (SEM) view: smooth body and sharp tip of the triangular suture needle; B) terminal part of a round section needle with conical tip; C) detail of the needle-thread interface woven in silk which must be «atraumatic»; D) conical tip; E) triangular tip.

designs, the dental community can improve clinical outcomes. Continuous research and adherence to safety standards are essential to optimize needle performance and reduce complications due to trauma from stitched surgical flaps.

There are several scientific studies on suture needles but, to the best of our knowledge, none of them address the problems related to the deformability of the needle based on the number of stitches that are applied to the oral tissues. Many studies described the deformability of the tissues crossed by the needle, the same deformability of the needle and the forces at play when applying the stitches on the various tissues; in this sense our study fills this gap in the literature.[19,20]

Materials and Methods

This study, which is part of a larger project that is based on scanning electron microscopy,[21] adhered to the principles outlined in the Declaration of Helsinki and received approval from the Institutional Review Board of the "Paolo Giaccone" University Hospital of Palermo (Protocol Code: #4-19-04-23). All patients participating in the study were provided with the informed consent, which they read and signed to express their willingness to participate in the research and consent to the publication of data.

This study was conducted *in vivo* on patients who required surgical dental treatment with the application of stitches in a variable number. The surgical interventions that were taken into consideration were the following: simple tooth extractions, complex extractions even of teeth in total inclusion, periodontal surgeries, insertion of implant, elimination of intraoral mucosal neoformations.

A total of 192 patients were selected who had to undergo necessary surgical treatment with stitches. The patients were aged between 18 and 50 years, 99 were men and 93 women, all of Italian nationality.

Needles with a triangular section and tip and needles with a circular section with a conical tip, both from two different brands (Ergon Sutramed Srl, Rome, Italy and Covidien, Wollerau, Switzerland), were tested.

All needles were divided into four groups according to the following scheme: i) Group A: Ergon Sutramed Srl, Rome, Italy, taper, half circle, 17.4 mm, 3-0, silk suture; ii) Group B: Ergon Sutramed Srl, Rome, Italy, taper cutting, half circle, 17.4 mm, 3-0, silk suture; iii) Group C: Covidien, Wollerau Switzerland, taper, half circle, 17 mm, 3-0, silk suture; iv) Group D: Covidien, Wollerau Switzerland, taper cutting, half circle, 17 mm, 3-0, silk suture.

Forty-eight patients were treated with group A needles, 48 patients with group B needles, 48 patients with group C needles, and the remaining 48 patients with group D needles.

Based on the clinical use of the needles on the patient, eight subgroups were created in each group according to the following scheme: i) Subgroup 1: needles used for 2 soft tissue crossings (one stitch); ii) Subgroup 2: needles used for 4 soft tissue crossings (two stitches); iii) Subgroup 3: needles used for 6 soft tissue crossings (three stitches); iv) Subgroup 4: needles used for 8 soft tissue crossings (four stitches); v) Subgroup 5: needles used for 10 soft tissue crossings (five stitches); vi) Subgroup 6: needles used for 12 soft tissue crossings (six stitches); vii) Subgroup 7: needles used for 14 soft tissue crossings (seven stitches); viii) Subgroup 8: needles used for 16 soft tissue crossings (eight stitches).

By combining groups A, B, C and D with the 8 subgroups, the research predicted 32 different clinical possibilities: A1-A8; B1-B8; C1-C8; D1-D8 (Table 1).

For each possible combination, 6 patients were treated for a total of 192 patients.

All sutures were performed by a single dentist, to avoid the possible influence of different operators, using a Mathieu-type needle holder and with care not to let the needle tip hit hard tissues such as teeth or the bone cortex.

After clinical use, the remaining unused thread was removed from each needle and immersed in an ultrasound tank for 5 minutes in order to eliminate any organic residues; when handling each needle, care was taken to prevent the tip from coming into contact with other surfaces in order not to further alter this delicate area.

All the needles were finally individually wrapped in paper-film and, for safety reasons, subjected to a sterilization cycle in autoclave at 132°C for 12 minutes.

Table 1. Combinations between groups and subgroups.

	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 4	Subgroup 5	Subgroup 6	Subgroup 7	Subgroup 8
Group A	Stitches: 1 Needle: tapered tip Brand: Sutramed	Stitches: 2 Needle: tapered tip Brand: Sutramed	Stitches: 3 Needle: tapered tip Brand: Sutramed	Stitches: 4 Needle: tapered tip Brand: Sutramed	Stitches: 5 Needle: tapered tip Brand: Sutramed	Stitches: 6 Needle: tapered tip Brand: Sutramed	Stitches: 7 Needle: tapered tip Brand: Sutramed	Stitches: 8 Needle: tapered tip Brand: Sutramed
Group B	Stitches: 1 Needle: triangular tip Brand: Sutramed	Stitches: 2 Needle: triangular tip Brand: Sutramed	Stitches: 3 Needle: triangular tip Brand: Sutramed	Stitches: 4 Needle: triangular tip Brand: Sutramed	Stitches: 5 Needle: triangular tip Brand: Sutramed	Stitches: 6 Needle: triangular tip Brand: Sutramed	Stitches: 7 Needle: triangular tip Brand: Sutramed	Stitches: 8 Needle: triangular tip Brand: Sutramed
Group C	Stitches: 1 Needle: tapered tip Brand: Covidien	Stitches: 2 Needle: tapered tip Brand: Covidien	Stitches: 3 Needle: tapered tip Brand: Covidien	Stitches: 4 Needle: tapered tip Brand: Covidien	Stitches: 5 Needle: tapered tip Brand: Covidien	Stitches: 6 Needle: tapered tip Brand: Covidien	Stitches: 7 Needle: tapered tip Brand: Covidien	Stitches: 8 Needle: tapered tip Brand: Covidien
Group D	Stitches: 1 Needle: triangular tip Brand: Covidien	Stitches: 2 Needle: triangular tip Brand: Covidien	Stitches: 3 Needle: triangular tip Brand: Covidien	Stitches: 4 Needle: triangular tip Brand: Covidien	Stitches: 5 Needle: triangular tip Brand: Covidien	Stitches: 6 Needle: triangular tip Brand: Covidien	Stitches: 7 Needle: triangular tip Brand: Covidien	Stitches: 8 Needle: triangular tip Brand: Covidien

The samples were observed by SEM (JEOL, mod. JSM 6390 LV, Tokyo, Japan) positioning them on suitable supports for electron microscopy; the morphological analysis under the scanning microscope was carried out using the secondary electron detector in order to have maximum detail of the surface morphology of the needles and highlight any deformations due to the impact with the soft tissues.

The SEM observation also allowed us to precisely measure some dimensional values of the tested needles to evaluate the homogeneity of the construction dimensional parameters and any differences between groups A, B, C and D.

For each type of needle belonging to all four groups, new needles were also observed in order to verify exactly what the initial morphological and dimensional conditions were. This allowed us to better evaluate and understand the SEM images of the needles deformed by the use.

In order to quantify the deformations, two different measurements were carried out on the SEM images. The first measurement assessed how long the terminal section of the needle that had become deformed was. The second measurement was carried out to evaluate how much the deformations protruded on the profile of the needle (Figure 2).

Means and relative Standard Deviations (SD) were calculated for each combination between groups and subgroups.

The data resulting from SEM observations were statistically analyzed by the SPSS Statistics IBM software, Version 20.0 using the ANOVA test; p values ≤ 0.05 were considered significant.

The null hypothesis was that there were differences in the found deformations between the two brands of needles, that there were no differences between the two types of conical and triangular tips and that there were no differences between the needles used for one or more stitches.

Results

All tested and under SEM observed suture needles showed homogeneity in diameters: the triangular section needles showed a diameter of 700 ± 18 µm; those with a round section have a diameter of 500 ± 22 µm (Figure 3).

The percentage of deformed needles was 53.12% (102 needles out of 192).

In patients in whom the needles were used to apply only one or

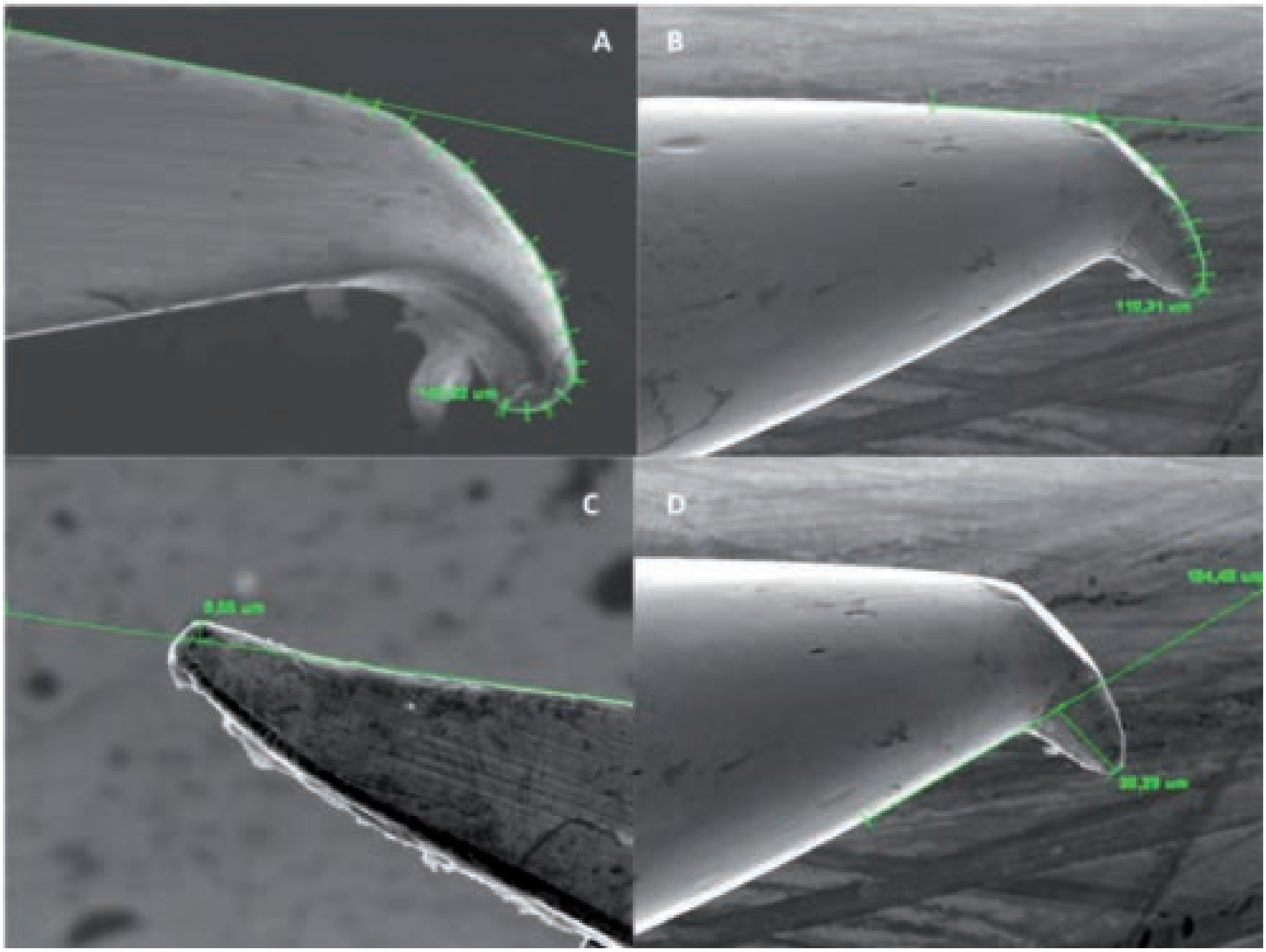

Figure 2. A) Measuring the length of the deformed part on a triangular pointed needle; B) measuring the length of the deformed part on a conical tip needle; C) measurement of the protrusion on the needle profile of the deformed part on a triangular tip needle; D) protrusion on the needle profile of the deformed part on a conical tip needle.

two stitches, no deformations were found; deformations begin to emerge after 6 crossings of the soft tissues (3 stitches) and these, although of moderate entity, concern 25% of the needles observed.

The number of deformed needles increases if the number of stitches applied increases; in fact, the maximum deformations were observed in subgroups 8 which involve 16 tissue crossings (8 stitches), where 95.83% of deformed needles are reached; comparing the 8 subgroups a statistically significant difference was found (P=0.03) and the relevant data are summarized in Table 2.

If we consider in detail the 32 combinations tested in the research, for subgroup 3 only the A3 combination (Sutramed, taper needle and six tissue crossings) did not show deformations; in fact, for the other combinations B3, C3 and D3 deformations were observed.

In group A, from subgroup 4 to subgroup 8 the number of deformations progressively increases; in group B, from the combination with subgroup 5 up to subgroup 8, 6/6 deformations are always recorded; in group C there is a sharp increase in the number of deformations going from the combination with subgroup 3 to subgroup 5; in group D the number of deformations increases noticeably from the combination with subgroup 4 to that with subgroup 5.

It should be noted that in the combinations involving subgroup 8, only in the case of A8 there was one needle out of 6 tested that was not deformed; in the other combinations B8, C8 and D8 the deformed needles were always «6/6». A prevalent number of deformations was not noted in the needles coming from a specific brand between the two tested; in fact, the differences were not statistically significant (P>0.05).

Table 3 summarizes all data relating to the number of deformations observed in the 32 possible combinations.

If we get into the matter of the deformations observed, our data highlights that, for the length of the deformed part, when subgroup 3 is involved, the highest average value was 21.94 µm and concerns triangular tip needles.

Within the four groups A, B, C and D, as the tissue crossings increase, the extent of the deformations also increases with statistically significant differences between the subgroups (p=0.03); the highest average value was found in the D8 combination: 148.61 µm. Table 3 highlights the average values and SD observed in all 32 combinations.

The data from our research also concerns how much the deformation protrudes compared to the profile of the needle: when subgroup 3 is involved, the highest average value was 10.66 µm and concerns triangular tip needles.

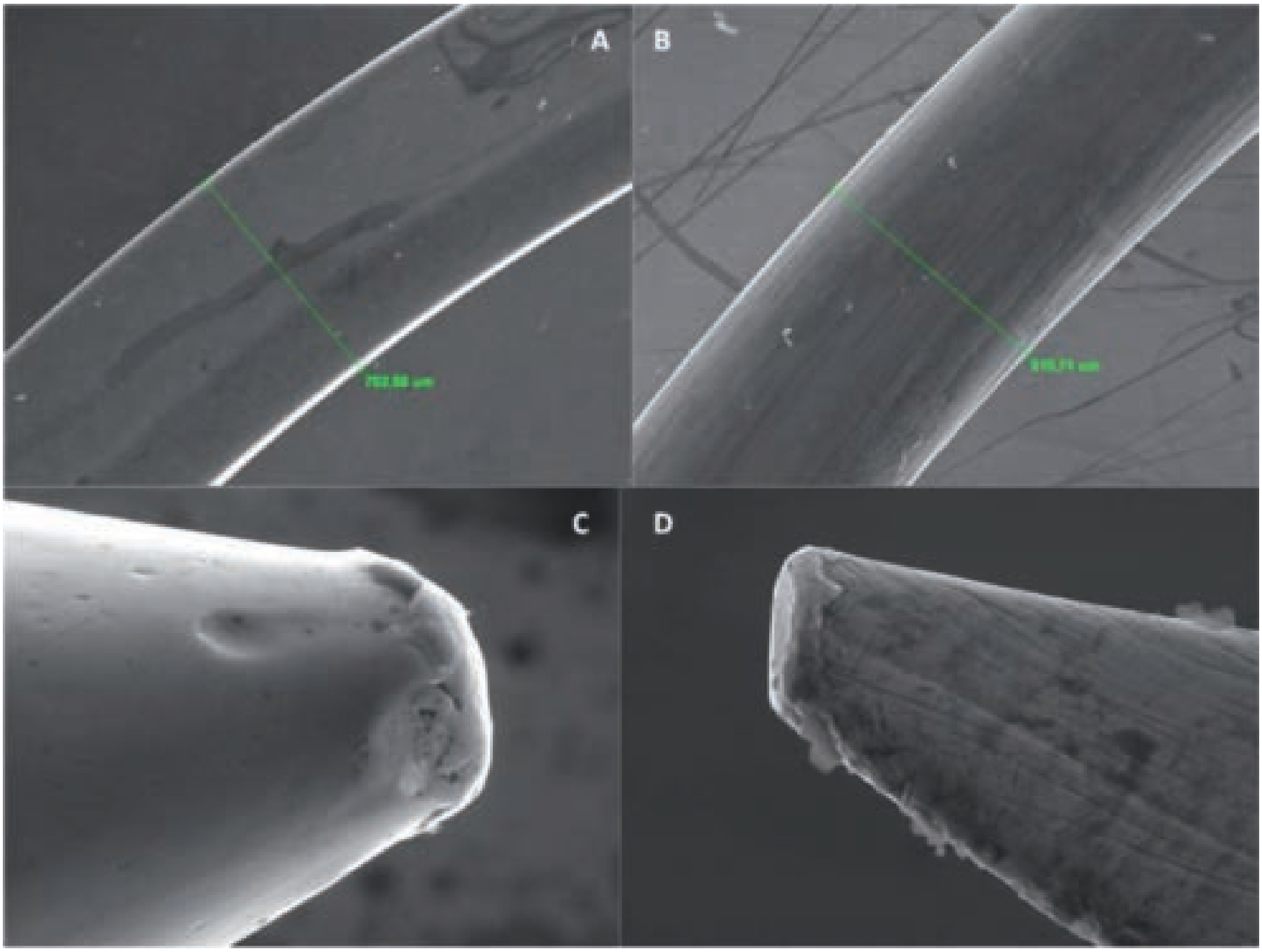

Figure 3. A) New triangular section needle; B) new circular section needle; C) rounded needle tips after the application of two stitches; D) triangular tip after two stitches.

Table 2. Number of deformations and percentage for each of the 8 subgroups made up of 24 samples and number of deformations considering the combinations between groups and subgroups.

Number of stictches	1	2	3	4	5	6	7	8	Deformations
Number of deformations	0/24	0/24	6/24	12/24	19/24	20/24	22/24	23/24	102 of 192
Percentage of deformation	0%	0%	25.00%	50.00%	79.16%	83.33%	91.66%	95.83%	
	Subgroup 1 Stitches: 1	Subgroup 2 Stitches: 2	Subgroup 3 Stitches: 3	Subgroup 4 Stitches: 4	Subgroup 5 Stitches: 5	Subgroup 6 Stitches: 6	Subgroup 7 Stitches: 7	Subgroup 8 Stitches: 8	Number of deformations per group
Group A Ergon Sutramed Taper	0/6	0/6	0/6	2/6	3/6	4/6	5/6	5/6	19/48
Group B Ergon Sutramed Triangular	0/6	0/6	3/6	4/6	6/6	6/6	6/6	6/6	31/48
Group C Covidien Taper	0/6	0/6	1/6	5/6	4/6	4/6	6/6	6/6	26/48
Group D Covidien Triangular	0/6	0/6	2/6	1/6	6/6	6/6	5/6	6/6	26/48
Number of deformations per subgroup	0/24	0/24	6/24	12/24	19/24	20/24	22/24	23/24	

Table 3. Average and standard deviations (SD) of the length of the deformations measured along the axis of the needle and the protrusion of the deformations in the various combinations between groups and subgroups.

MEAN/SD A1 0.00/NA	MEAN/SD A2 0.00/NA	MEAN/SD A3 0.00/NA	MEAN/SD A4 24.44/±4.02	MEAN/SD A5 36.83/±3.48	MEAN/SD A6 38.22/±6.87	MEAN/SD A7 81.74/±2.48	MEAN/SD A8 99.47/±1.68
MEAN/SD B1 0.00/NA	MEAN/SD B2 0.00/NA	MEAN/SD B3 21.94/±2.85	MEAN/SD B4 28.81/±3.38	MEAN/SD B5 34.47/±2.52	MEAN/SD B6 47.66/±13.74	MEAN/SD B7 93.83/±6.63	MEAN/SD B8 143.02/±26.18
MEAN/SD C1 0.00/NA	MEAN/SD C2 0.00/NA	MEAN/SD C3 9.24/NA	MEAN/SD C4 21.85/±1.91	MEAN/SD C5 29.86/±2.09	MEAN/SD C6 41.36/±4.65	MEAN/SD C7 80.86/±3.37	MEAN/SD C8 104.93/±4.93

Averages and standard deviations of the length of the deformations (μm). NA, not applicable.

MEAN/SD D1 0.00/NA	MEAN/SD D2 0.00/NA	MEAN/SD D3 14.56/NA	MEAN/SD D4 25.02/NA	MEAN/SD D5 36.94/±9.30	MEAN/SD D6 50.03/±9.80	MEAN/SD D7 94.76/±8.24	MEAN/SD D8 148.61/±31.43
MEAN/SD A1 0.00/NA	MEAN/SD A2 0.00/NA	MEAN/SD A3 0.00/NA	MEAN/SD A4 11.38/±1.42	MEAN/SD A5 18.07/±2.21	MEAN/SD A6 17.23/ ±5.47	MEAN/SD A7 34.68/±8.49	MEAN/SD A8 44.42/±6.31
MEAN/SD B1 0.00/NA	MEAN/SD B2 0.00/NA	MEAN/SD B3 10.66/±1.63	MEAN/SD B4 13.18/±2.49	MEAN/SD B5 16.59/±2.63	MEAN/SD B6 23.55/±8.37	MEAN/SD B7 45.50/±7.95	MEAN/SD B8 68.61/±16.96
MEAN/SD C1 0.00/NA	MEAN/SD C2 0.00/NA	MEAN/SD C3 9.24/NA	MEAN/SD C4 11.40/±4.51	MEAN/SD C5 13.80/±3.01	MEAN/SD C6 17.43/±5.07	MEAN/SD C7 38.00/±6.42	MEAN/SD C8 48.06/±8.78
MEAN/SD D1 0.00/NA	MEAN/SD D2 0.00/NA	MEAN/SD D3 7.22/±5.65	MEAN/SD D4 12.57/NA	MEAN/SD D5 18.61/±6.11	MEAN/SD D6 25.16/±6.54	MEAN/SD D7 49.00/±4.13	MEAN/SD D8 69.70/±9.08

Averages and standard deviations of the length of the deformations (μm). NA, not applicable.

Within the four groups A, B, C and D, as the tissue crossings increase, the extent of the protrusions from the needle profile also increases, with statistically significant differences between the subgroups (p=0.02); the highest average value was found in the D8 combination: 69.70 μm. Table 3 highlights the average values observed in all 32 combinations.

Even if our study does not evaluate the clinical perceptions of the dentist who performed the sutures, it is important to highlight that episodes of sensation of loss of the ability of the needles to pass through the tissues after the application of 4 sutures (eight crossings of soft tissues) were reported.

Probably, the tip of the needle, by rounding or deforming, transmits to the operator the sensation of loss of sharpness which becomes less effective and, therefore, the needle itself must be pushed with more force.[22]

Discussion

Our research highlights that the sharp and cutting tip of the suture needles is the weakest part and most prone to deforming when it counteracts the elasticity of the mucosa allowing the needle to pass through the soft tissues. Even if the consistency of the examined oral tissues is not high, it seems to be sufficient to bend the most extreme and thin part of the needle tip which becomes deformed especially if it passes through the tissues several times.[23]

The null hypothesis that there were differences in the deformations found between the two brands of needles must be rejected. In fact, comparing the needles of the two different manufacturers tested, there were no statistically significant differences. In the comparison between the two groups A and C and the other two groups B and D, considering the number of deformed needles, it can be stated that there were no differences between the needles of the two different brands. In details, considering both the length of the deformations and the protrusion compared to the profile, no differences were found between the two brands.

The null hypothesis, which predicted that there were no differences in the deformation induced on the suture needle during use depending on how many times the tissues were traversed, must be also rejected.

In fact, the values relating to the deformation measured along the needle increased going from subgroup 1 to subgroup 8. This increasing deformation was noted for needles from both manufacturers and for both triangular-tip and conical-tip needles.

The null hypothesis according to which there were no differences in the deformation between the two types of needle tip (conical and triangular) must be rejected too. By comparing the deformations of the round tip needles with those of the triangular pointed needles, statistically significant differences were found.

Triangular tip needles, under the same clinical conditions (number of soft tissue crossings), have proven to be much more deformable, probably because the end of the needle, due to sharpening, becomes very thin and therefore bends or deforms easily. The conical-tip needles, on the other hand, have, especially when new, a tip that is not too sharp and pointed,[24] which, thanks to its thickness, seems to better resist impact with the soft tissues to be sutured. Our research highlights that the tip of suture needles is sufficiently resistant to deformation when used for no more than 2 stitches. In these cases, a simple and moderate rounding of needle tip has been sometimes observed in both the case of the triangular tip and the conical one (Figure 3).

After 3 stitches and therefore 6 soft tissue crossings, deformations begin to emerge, which, measured both along the length of the needle and protrusions, appear rather small. In fact, in these cases the needle only partially loses its original sharpness. These considerations are valid for both triangular-tipped and conical-tipped needles.

Unfortunately, the extent of the deformations increases further depending on the number of times the mucosa is punctured and the needle crosses the soft tissues, which resist advancement, in any case.

In fact, our study highlighted that the length of the deformations becomes maximum when the needle is used for 8 stitches (16 tissue crossings) and the maximum deformation is observed on triangular-tipped needles. Also, with regard to the deformation of the needle, understood as protrusion on the profile, the trend of the measurements reflects what was described above. Also in this case, increasing the number of stitches applied with the same needle increased the protrusions on the tip profile. Our research has a clinical/biological implication as limiting the use of a single needle to a reduced number of tissue crossings could lead to faster healing processes of the incised tissues. A needle that remains atraumatic in all its parts would not induce further inflammatory phenomena perhaps correlated with tissue laceration which would be induced by sharp irregularities such as those observed under SEM during the study. Thus, even when the clinician could be induced to continue using the same needle to place additional stitches, especially if the supplied thread is long enough and allows this, he/she should instead change the needle in order to avoid unwanted lacerations of the delicate oral tissues. Our study has the limitation of having tested the needles used in the context of soft tissues, taking care not to let the tip touch hard tissues (such as teeth or the bone cortex); these conditions could clinically occur, inducing further deformations which would be appropriate to investigate.

Another limitation of the study is having tested only one type of needle (even if with two different tips): diameter 3-0 United States Pharmacopeia (USP), half circle, length 17 mm. Other shapes and sizes could produce different results, depending on the forces induced on the needle body by the needle holder.

Even if our research aimed to eliminate the operator variable by using a single experimenter, it would be useful to test and compare the results deriving from operators with different clinical experience.

This article is part of a line of research that intends to continue investigations on the other variables mentioned above. The strong point of the study is that it has highlighted, thanks to the use of the scanning microscope, morphological alterations of the needles that the dentist cannot detect during clinical use.

These alterations could have repercussions on the patient's health.

Conclusions

The tested suture needles appear to be mechanically resistant but the tip remains, regardless of the shape, the most deformable part, especially if the same needle is used to apply many sutures. Any improvements in both the shape of the needle tip and the alloy used could improve clinical performance on sutured tissues.

It is suggested to limit the number of crossings of tissue by the single needle during the application of the stitches. During normal clinical conditions the suture needle is used until the supplied thread runs out. If this thread is particularly long, the dentist could be forced to use this needle for more sutures than the needle itself can perform without deforming. As regards the fields of application of sutures in dentistry, considering the consistency and mechanical resistance of the oral soft tissues, it seems appropriate to change the needle after the application of 4 or 5 stitches in order to maximize the physical characteristics of the tip such as its cutting capacity. The conical tip of the suture needles is more resistant to the mechanical stress induced by passing through the soft tissues.

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