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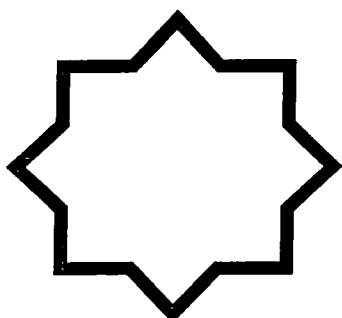
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(54) Title: IMPROVED SURGICAL THREAD



(57) Abstract: In order to make improved threads provided with barbs for surgical purposes, it is envisaged to use threads of polyhedral or stochastic shape and to provide the barbs on said threads, by making a cut in a point corresponding to an edge of the aforesaid polyhedral or stochastic shapes for each barb, preferably by means of techniques of laser etching that enable also barbs with double tip to be obtained so as to increase the biological and histomorphological interaction with the tissues of the host.

IMPROVED SURGICAL THREAD

The present invention relates to the medical sector and, in particular, to an improvement to surgical threads provided with inclined protuberances or hooks or protrusions of any shape, to be used for operations of plastic surgery, dermatological surgery, aesthetic surgery, general surgery and emergency surgery, and in all forms of specialistic surgery. Threads provided with barbs or protrusions with characteristic arrangements and shapes have been widely described (Alcamo, US patent No. 3 123 077; Fukuda, US patent No. 4 467 805; Ruff, US patent No. USA 5 342 376).

The threads currently available on the market all have a circular section. Even though there has been hypothesized the possibility of using threads with different section, so far this has remained a pure speculation without any practical utility since no indication has ever been given on the technical or biological expedience or need to resort to thread sections of this type.

In particular, no teaching has been provided in relation to the use of threads with sections of a polygonal type or more in general threads with a polyhedral or stochastic geometrical shape for providing threads having barbs that could be distributed along the plurality of edges of said sections, nor have methods been described that make it possible, in a fast and convenient way, by making cuts on said edges using improved machine tools, to obtain

the barbs of a thread to be used both for plastic and cosmetic surgery and for general surgery.

The task of the present invention is to provide a method that envisages using, in order to obtain barbed
5 threads, for surgical purposes, threads having a polyhedral or stochastic shape and providing barbs on said threads by making a cut in a point corresponding to an edge of the aforesaid polyhedral or stochastic shapes for each barb. This makes it possible:

10 to obtain the product in a simpler way, with an increase in the biological and histomorphological interaction with the tissues of the host;

to make, in a precise point of the thread, or spatial co-ordinates of the section of the thread, a
15 minimum number of barbs equal to the number of edges possessed by the polyhedral geometrical sections or an even higher number in the case of stochastic sections.

In addition, the method described enables obtaining of:

20 a higher density of barbs per unit length of the thread, as well as in a specific point along the axis of the thread;

a geometrical increase in the intensity of the force of gathering exerted on the soft tissues of the
25 human body neighbouring upon the areas captured by the barbs; and

a greater interaction with the histiocyte-reticulum cell system (mast-cells or histiocytes and macrophages) of the extracellular matrix of the
30 connective tissue in which the threads will be inserted.

As a result, there will be a qualitative increase in the formation of fibrous tissue, which will have a structure that is more effective, more compact, and more durable in time, and will have a greater effect of
5 tissue revitalisation (histological rejuvenation of the tissues of the host), as has been demonstrated by the scientific research conducted by the present applicant.

Consequently, forming a first subject of the present invention is a method for making barbed threads
10 for surgical use in accordance with Claim 1.

Forming another subject of the present invention is a surgical thread provided with protuberances or barbs, in which said barbs have a non-conventional shape with double tip, which enables a further increase
15 in the intensity of the force of gathering exerted on the soft tissues neighbouring upon the areas captured by the barbs.

Further characteristics and advantages of the invention will emerge clearly from the ensuing
20 description, with reference to the attached plates of drawings, which illustrate merely by way of non-limiting example some preferred embodiments thereof:

Figure 1 shows a thread having a section with the shape of an isosceles triangle;

25 Figure 2 shows a thread having a section with the shape of a right triangle;

Figure 3 shows a thread with a rhomboidal section;

Figure 4 shows a thread having a section shaped like a parallelogram;

30 Figures 5 to 17 show threads with a polygonal section with n sides, where n is comprised between 5

and 17;

Figure 18 shows a thread having a stochastic section;

Figure 19 shows a barbed thread, the section of
5 which is indented];

Figures 20 and 21 show two barbed threads, the sections of which are serrated in a counterclockwise direction and in a clockwise direction, respectively;

Figure 22 is a section with indentations arranged
10 as in the previous figures but with variable length of the barbs;

Figures 23 and 24 show two barbed threads with sections shaped like irregular stars;

Figures 25 and 26 show two threads in which the
15 barbs have double tips; and

Figure 27 shows an example of a mechanical cut made on a thread with triangular section.

With reference to the figures, Figures 1 and 2 may be considered, where the section is the one with the
20 smallest number of edges, namely, a triangular section.

According to the invention, along each of the edges there can be obtained, by means of appropriately inclined cuts, barbs of the desired length, set at an appropriate distance apart from one another.

25 The cut can be made either mechanically (Figure 27) or via laser means, using a machine that employs a laser beam as blade for cutting and determining the shape of the protuberances, with a size of the beam of monochromatic light of high intensity ranging from
30 10^{-7} mm to 1 mm.

Advantageously, by working with the laser beam in

infinitesimal time intervals, it is possible to produce barbs or protuberances having their own axis inclined with an angle that varies in the range from 5° to 85° with respect to the axis of the thread with polygonal section (Figures 3-17) or stochastic section (Figure 5 18).

The length of the barbs can range from 0.2 mm to 2.5 mm according to the intensity and focusing of the collimated laser beam used.

10 The shapes of the barbs can vary according to the shapes and/or regular volumes of Euclidean geometry that are chosen or in the stochastic shapes.

With the technique of laser etching of threads having polygonal sections, there can be obtained also 15 barbs shaped like a truncated pyramid of variable size, and said barbs can be made with more complex shapes; for example, it is possible to provide externally serrated barbs with the base of the truncated pyramid that is an isosceles triangle or has a stochastic shape 20 (Figures 20-22).

There may likewise be obtained, according to a further characteristic of the invention, barbs with a double tip like the ones illustrated in Figures 25 and 26, which enable, even in a thread with circular 25 section, an increase in the biological and histomorphological interaction with the tissues of the host.

CLAIMS

1) A method for making threads provided with barbs for surgical use, characterized in that it envisages using threads of polyhedral or stochastic shape that are able to offer a plurality of edges and providing on said threads a plurality of barbs by making a cut in a point corresponding to an edge of the aforesaid threads having polyhedral or stochastic shapes for each barb that it is desired to obtain.

2) The method as per Claim 1, characterized in that it envisages making in a precise point of the thread, or spatial co-ordinates of the section of the thread, a minimum number of barbs equal to the number of edges possessed by the polyhedral geometrical shapes or even higher in the case of stochastic shapes.

3) The method as per Claim 1, characterized in that the cut is a mechanical cut or a laser cut, in the latter case said cut being obtained with a machine that uses a laser beam as blade for cutting and determining the shape of the protuberances, with a size of the monochromatic light beam of high intensity that varies from 10^{-7} mm to 1 mm.

4) The method as per the preceding claim, characterized in that by working with the laser beam in infinitesimal time intervals, it is possible to produce barbs or protuberances having their own axes inclined with an angle that varies in the range from 5° to 85° with respect to the axis of the thread with polyhedral or stochastic shape.

5) The method as per Claim 4, characterized in that by varying the intensity and focusing of the

collimated laser beam used, the length of the barbs can vary.

6) The method as per Claim 5, characterized in that the length of the barbs can range from 0.2 mm to
5 2.5 mm.

7) The method as per any one of the preceding claims, characterized in that along each edge of the thread it is possible to make a number of barbs set at an appropriate distance apart from one another.

8) A surgical thread provided with protuberances or barbs, to be used for operations of plastic surgery, dermatological surgery, aesthetic surgery, and emergency surgery, said surgical thread being characterized in that it presents polyhedral or
10 stochastic shapes, which are able to offer a plurality of edges on which said barbs are made.
15

9) The surgical thread as per the preceding claim, characterized in that said barbs are obtained by making a cut in a point corresponding to at least one
20 of the edges of the aforesaid polyhedral or stochastic shapes for each barb.

10) The surgical thread as per Claim 8, characterized in that it presents in a precise point of the thread, or spatial co-ordinates of the section of
25 the thread itself, a minimum number of barbs equal to the number of edges possessed by the polyhedral geometrical shape thereof.

11) The surgical thread as per Claim 9, characterized in that the barbs are shaped like a
30 truncated pyramid.

12) The surgical thread as per Claim 9,

characterized in that the barbs have a length comprised between 0.2 mm and 2.5 mm.

13) The surgical thread as per Claim 11, characterized in that in one and the same geometrical
5 section of the thread the barbs are of different lengths.

14) The surgical thread as per Claim 9, characterized in that the barbs are serrated along their margins.

10 15) The surgical thread as per any one of Claims 8 to 14, characterized in that the barbs have their own axes inclined with an angle that varies in the range from 5° to 85° with respect to the axis of the thread with polyhedral or stochastic shape.

15 16) A surgical thread provided with protuberances or barbs to be used for operations of plastic surgery, dermatological surgery, aesthetic surgery, and emergency surgery, characterized in that one or more of said barbs is provided with a double tip.

20 17) The surgical thread as per Claim 16, characterized in that the tips of said barbs with double tip are divaricated.

18) The surgical thread as per any one of Claims 8 to 17, characterized in that made along each edge of
25 the thread is a number of barbs set at an appropriate distance apart from one another.

19) A surgical thread provided with inclined protuberances or barbs to be used for operations of plastic surgery, dermatological surgery, aesthetic
30 surgery, general and emergency surgery, substantially as described and illustrated in the attached plates of

drawings.

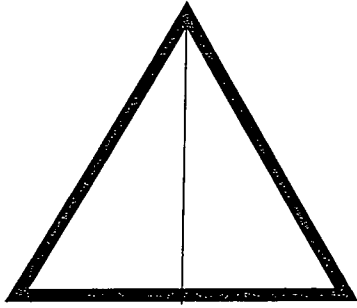


FIG. 1

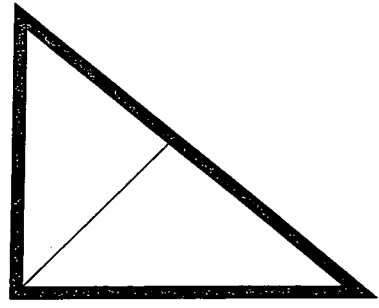


FIG. 2

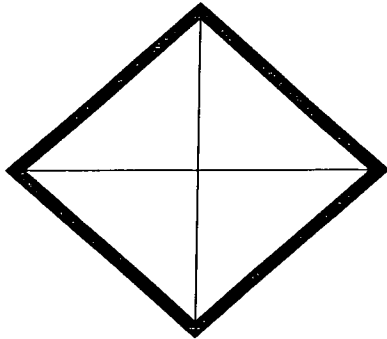


FIG. 3

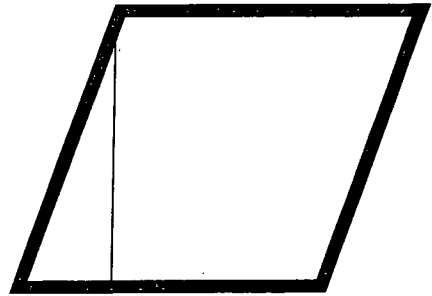


FIG. 4

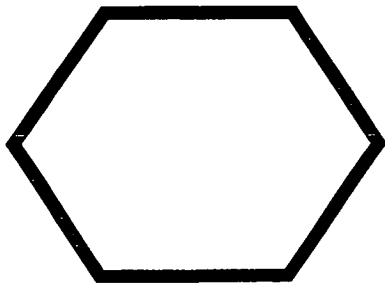


FIG. 5

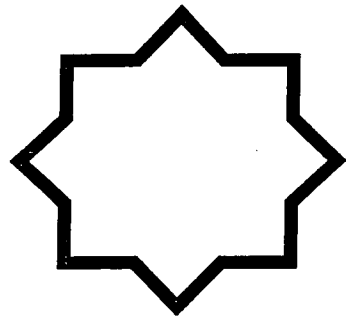


FIG. 6

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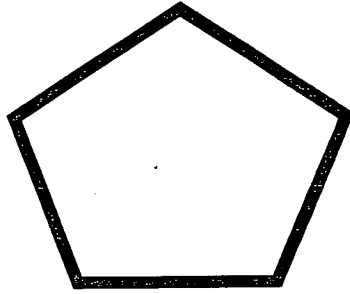


FIG. 7

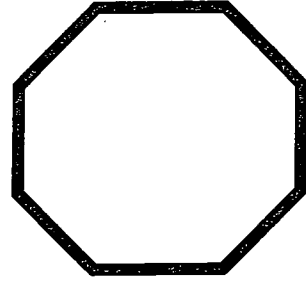


FIG. 8

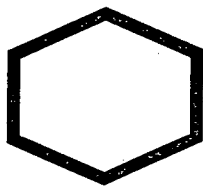


FIG. 9

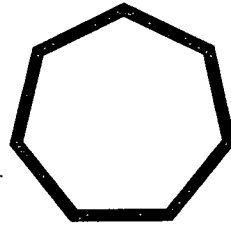


FIG. 10

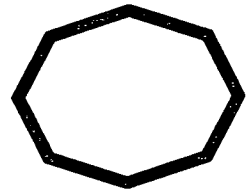


FIG. 11

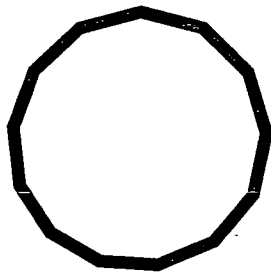


FIG. 12

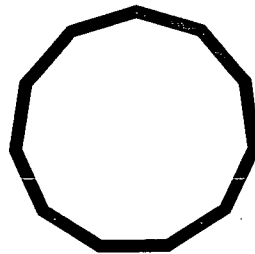


FIG. 13

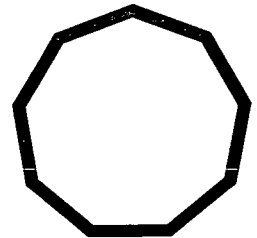


FIG. 14

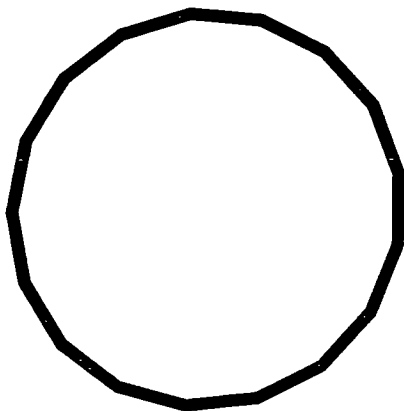


FIG. 15

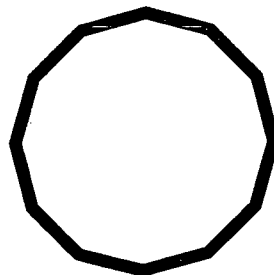


FIG. 16

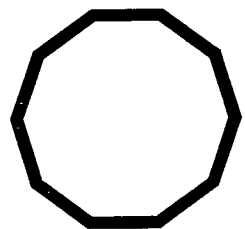


FIG. 17

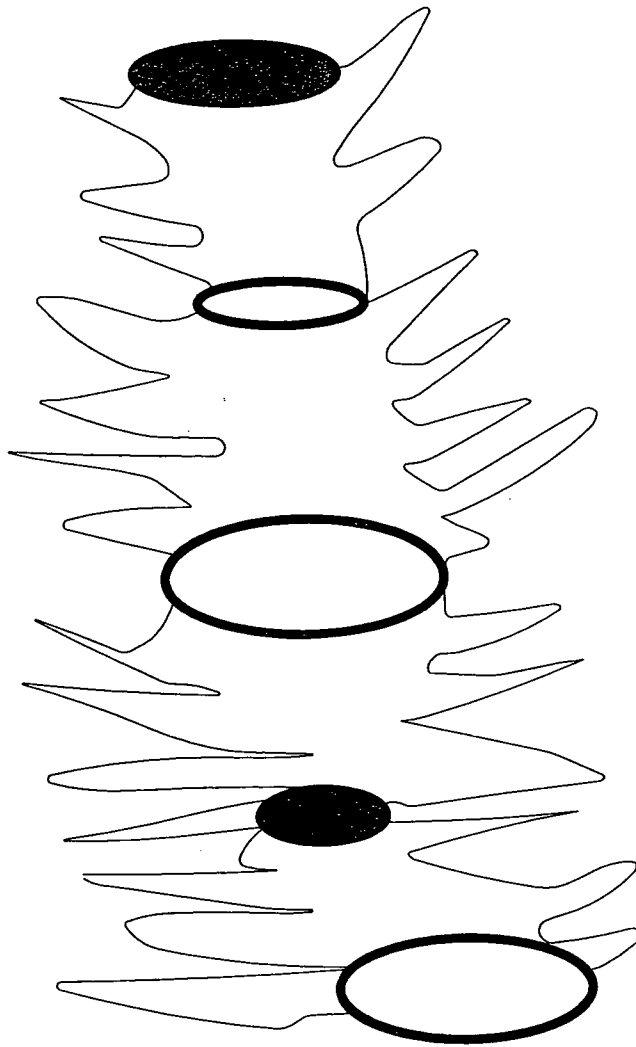


FIG. 18

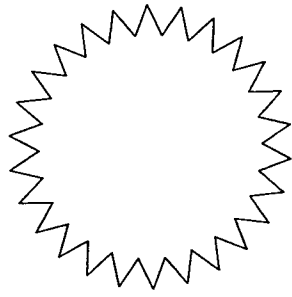


FIG. 19

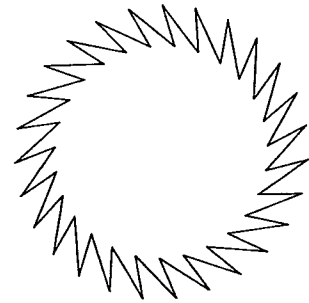


FIG. 20

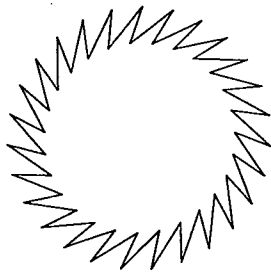


FIG. 21

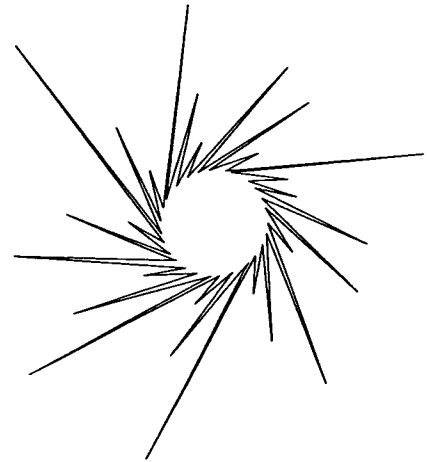


FIG. 22

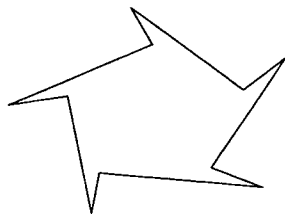


FIG. 23

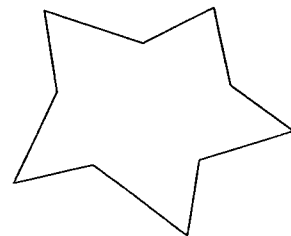


FIG. 24

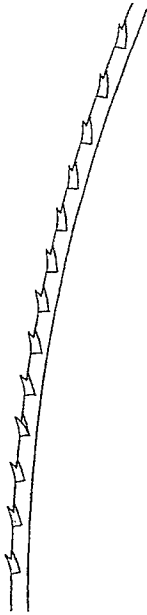


FIG. 25

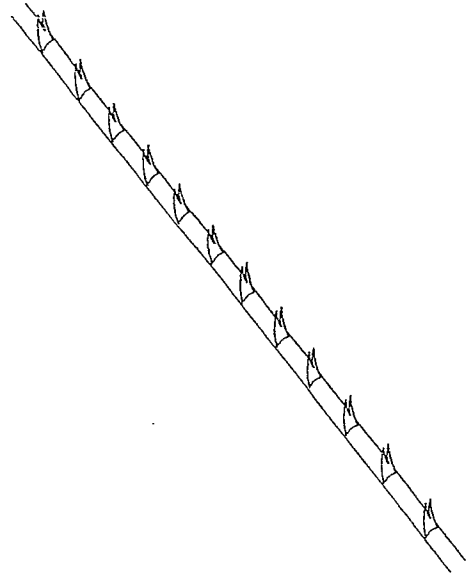


FIG. 26

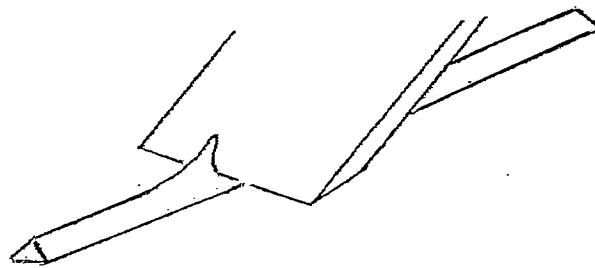


FIG. 27