



Comparison of inflammatory response to polyglytone 6211 and polyglecaprone 25 in a rat model

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The aim of this study was to compare polyglytone 6211 (Caprosyn) and polyglecaprone 25 (Monocryl) in intracuticular skin closure in a rat model. The inflammatory response to these two suturing materials was assessed. Comparative studies involving polyglytone 6211 could not be found, and little is known about the wound-healing properties of polyglytone 6211.

Caprosyn is a new absorbable, synthetic, monofilament suturing material. The generic name is polyglytone 6211; it has a tensile strength of 10 days and an absorption profile of 56 days, and it is made by Tyco Healthcare (Halfway House, Gauteng, South Africa). The more familiar Monocryl is also an absorbable, synthetic, monofilament suturing material. The generic name is polyglecaprone 25, it has a tensile strength of 21 days and an absorption profile of 90 - 120 days, and it is made by Ethicon, Johnson and Johnson (Midrand, Gauteng, South Africa).

Tensile strength measures the time it takes for the suturing material to lose 70 - 80% of its initial tensile strength. Initial tensile strength is a measure of the amount of tension applied in a horizontal plane necessary to break the suturing material.

The absorption profile indicates the time it takes for the suturing material to undergo mass absorption in human tissue. This absorption is accomplished by human phagocytes, for example tissue macrophages.

Background

Nowadays many wounds are closed intracutaneously in order to prevent cross-hatching. Both absorbable and non-absorbable suturing materials are used for this purpose. Non-absorbable sutures have to be removed, which is time consuming and rather unpleasant for the patient. Absorbable sutures can remain in place, and as an additional advantage, might influence the scarring process favourably. This depends on the physical properties of the specific material.^{1,2}

It is a known fact that the inflammatory response towards a specific suturing material plays an important role in the scar result. Other factors such as infection, nutritional status of the patient, drugs used by the patient, blood supply to the specific area, tension across the wound edges, inter-individual patient response and surgical technique also play a role in the scar result.^{1,2}

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The aforementioned factors can be controlled and improved to provide a near-ideal situation; however, the search for a so-called ideal suturing material is ongoing. An ideal suturing material will obviously depend on the clinical situation for which it is needed. Qualities like adequate approximation, support and low immunogenicity are important and define a so-called ideal suture material.

Materials and methods

An experimental animal model was used, involving 10 Wiscott adult male rats. Approval by the Animal Ethics Committee and the Research, Ethics and Publications Committee of the Medical University of Southern Africa (now the University of Limpopo) was granted for the project. The rats were anaesthetised using intraperitoneal thiopental sodium 5 mg/kg. The fur on their abdomens was removed in order to expose the abdominal skin.

Three bilateral full-thickness longitudinal skin incisions were made in tandem on each rat's abdominal wall (Fig. 1). As such there were three pairs of incisions, namely top, middle and bottom. Both suturing materials were used in each rat. Using a random method either polyglytone 6211 or polyglecaprone 25 was used on the left side, and the other suturing material on the right side. Equivalent needles were used for skin closure (Caprosyn 5/0, 11 mm cutting needle, Monocryl 5/0, 13 mm



Fig 1. The abdomen of a rat illustrating the position of the incisions. This picture was taken 10 days after the intracuticular closure was done.



cutting needle). The same surgeon did the intracuticular sutures for all the rats, so surgical technique was constant.

After 2 days, representing the acute phase of the inflammatory response, the first set of punch biopsies was taken from the top sites. After 10 days, representing the subacute phase of the inflammatory response, a second set of punch biopsies was taken from the middle sites. The size of the punch was 5 mm in diameter and therefore only a segment of the wound was taken for examination. Only one biopsy was taken from each wound. The pathologist was kept blinded to ensure unbiased examination of all the specimens.

For interest's sake the bottom sites were used to assess the aesthetic quality of the scar. Scar width, redness and skin quality were assessed, but these data were not included in the results. Only the inflammatory response data from the top two pairs of incisions were used in this study.

Histological examination

It is important to note that a microscopic evaluation was done. The high cost of immunohistochemical analysis made this method of calculating the inflammatory response impractical.

The inflammatory response was measured by looking at the neutrophil, macrophage and lymphocyte responses surrounding the foreign body, in this case the suturing material. Special stains were done to identify the lymphocytes. Individual cell responses were quantified arbitrarily as mild, moderate, severe or extreme, with corresponding numbers 1 - 4 respectively, in order to do a quantitative analysis of the inflammatory response. The number and type of specific cells surrounding the foreign material (suture) were counted by the pathologist in a high-power field. Table I shows how these numbers were allocated to the different cell types present in a high-power field.

It is interesting to note that mast cells and eosinophils were observed in two different specimens, both involving Monocryl (Fig. 2).

Mathematical assessment

The inflammatory response was assessed mathematically using both comparison *t*-tests and non-parametric Wilcoxon's tests. Comparison of the inflammation was done by looking at three individual cell types comprising the inflammatory response. Measurements of each cell type, using a grading system as

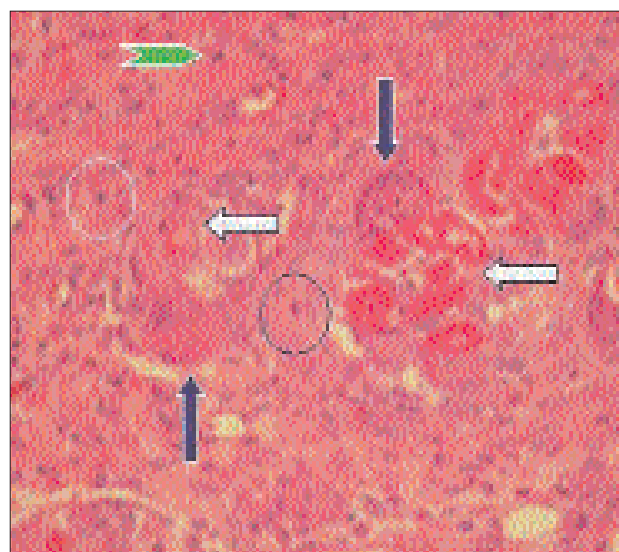


Fig. 2. Histological analysis on day 10. Suture material (white arrows), giant cells (black arrows), lymphocytes (green chevron), mast cells (white circle) and eosinophils (black circle). The suturing material used here was Monocryl.

described earlier, were used to calculate an indication of inflammatory response. Inflammatory response as a whole was not measured. The term 'inflammatory response' will be used for the sake of simplicity.

The inflammatory response, subdivided into the three most important inflammatory cell groups, was compared on days 2 and 10 respectively. Change in the inflammatory response was also assessed, again using the three cell types, from days 2 to 10 (Table II).

Although Wilcoxon's tests were preferred for these data because the scale of measurement was discrete, viz. 1 - 4, *t*-tests were computed as well because the data contained many 'ties' and this substantially reduced the power of the Wilcoxon's tests. The *t*-test statistics and Wilcoxon's test statistics were highly correlated, as were their respective *p*-values (Table III).

Results

The results were statistically significant. There was also a good correlation between the two mathematical methods used to compare the data.

Table I. Number and type of cells surrounding the foreign material (suture), and the corresponding grades given to the number and type of cells present

Neutrophils		Macrophages		Lymphocytes	
Number	Grading	Number	Grading	Number	Grading
< 5	1	Not present	1	< 5	1
> 5	2	Present	2	> 5	2
> 10	3	Epithelioid cells present	3	> 10	3
Abscess present	4	Giant cells present	4	> 20	4



Table II. Comparison of values for the inflammatory response for the 3 different cell types on days 2 and 10 respectively

Inflammatory cell	Time (days)	Rat Suture	1		2		3		4		5		6		7		8		9		10	
			M	C	M	C	M	C	M	C	M	C	M	C	M	C	M	C	M	C	M	C
Lymphocyte	2		2	3	1	1	1	1	1	2	0	0	0	2	2	2	2	2	2	2	2	2
	10		4	4	2	4	4	4	4	4	4	4	4	3	2	3	4	4	4	4	4	4
Macrophage	2		2	3	1	1	1	1	2	0	0	0	2	2	2	2	2	2	2	2	2	2
	10		4	4	2	4	4	4	4	4	4	4	4	3	2	3	4	4	4	4	4	4
Neutrophil	2		3	4	4	2	3	3	2	2	2	3	2	3	3	2	2	3	3	3	3	3
	10		1	1	1	1	1	1	1	1	2	1	3	1	1	1	1	1	2	4	1	

M = Monocryl; C = Caprosyn.

Table III. Comparison of the *t*-statistics and Wilcoxon's statistics and their *p*-values

Inflammatory cell	Period (days)	<i>t</i> -statistic	W-statistic	<i>p</i> -value (<i>t</i>)	<i>p</i> -value (<i>W</i>)
Lymphocyte	2	+ 0.00	+ 0.00	1.00	1.00
	10	+ 1.96	+ 1.67	0.08	0.10
Macrophage	2	- 1.81	- 1.66	0.10	0.10
	10	- 0.80	- 0.58	0.44	0.56
Neutrophil	2	+ 0.80	+ 0.58	0.44	0.56
	10	- 0.25	- 0.76	0.81	0.45

t = *t*-test; *W* = Wilcoxon's test.

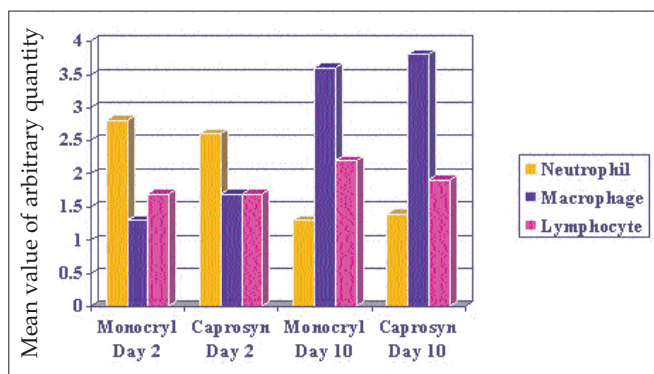


Fig. 3. Mean values of arbitrary quantity (vertical axis) for the different inflammatory cell types evaluated on days 2 and 10 (horizontal axis) respectively.

No significant difference was observed in the inflammatory response on days 2 or 10 (Fig. 3). Also, no significant difference was observed in the change in the inflammatory response that took place from days 2 to 10.

Conclusion

The question addressed in this study was whether there was any significant difference between polyglytone 6211 and polyglecaprone 25 regarding inflammatory response in the

acute and subacute phase of wound healing after suture placement. The presence of mast cells and eosinophils might suggest that polyglecaprone 25 had an increased tendency to evoke an allergic reaction, but a definitive conclusion cannot be drawn as yet.

Although a small sample size was used and the study was conducted over a short period, the information obtained proved useful. Polyglytone 6211 seems to be similar to polyglecaprone 25 with regard to inflammatory response. As the inflammatory response was investigated in a rat model, the findings cannot be extrapolated to humans. Similarly, the results on wound aesthetics will need to be investigated in a future study involving human subjects. The results of this experimental study using a rat model will serve as a basis for a future clinical study.

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1. Breed CM, van der Biezen JJ, Marck KW. Slowly and rapidly absorbable sutures and their influence on scar width. *European Journal of Plastic Surgery* 1999; 22: 251-254.
2. Guyuron B, Vaughan C. A comparison of absorbable and nonabsorbable suture materials for skin repair. *Plast Reconstr Surg* 1999; 56: 372-377.