Design, Fabrication and Functional Evaluation of Textile Packing Material for Tissue Debridement

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Statement of Purpose: The problem of non-healing chronic wounds can be best explained by the fact that the normal cascade of wound healing has been disrupted. In order to start the process of regular wound healing, the first step must be to achieve adequate debridement[1], which aims to remove dead, necrotic and contaminated tissue from the wound and the surrounding area until the underlying healthy tissue is exposed[2]. Various types of debridement methods are currently used in today's clinic, such as autolytic, enzymatic, biodebridement, mechanical, and surgical debridement techniques. Each has its own particular advantages as well as limitations, such as time-consuming, high cost, less acceptability, low tolerance and inadequate availability. In order to provide a safe, inexpensive, easier and more efficient debridement technique, a special textile packing material has been designed, fabricated and evaluated. However there is no agreed standard to evaluate its functionality and performance. So the main goal of this study has been to establish an appropriate evaluation system that could be applied to all textile packing materials.

Methods: In order to function efficiently for debridement, the textile packing material should have good biocompatibility, high liquid absorption, avoid particulate and fiber shedding and provide sufficient mechanical properties. Thus the proposed evaluation system has focused mainly on these four functional properties and the following tests were selected to better describe the performance of the various candidates (Table 1).

Table 1. Different test methods and their standards

Properties	Test Methods	Standards
Biocompatibility	*In vitro* cytotoxicity	ISO 10993-5
	Irritation and sensitization test	ISO 10993-10
Liquid absorption	Liquid absorption capacity (LAC)	ISO 9073-6
Fiber fragment and particulate shedding	Dry friction test	GB/T 4802.1
	Wet sonic oscillation	YY/T 0472.2
Mechanical properties	Tensile test	ISO 13934-1
	Compression test Bending test	ISO 9073-7

To verify this evaluation protocol, the textile packing material and a commercial Winner® gauze swab (Winner Medical, Shenzhen, China) were tested according to this proposal. The basic structure and mass per unit area of these samples are listed in Table 2.

Table 2. Structural characteristics

Samples	Basic structure	Mass per unit area (g/m^2)
Textile packing material	High pile knit	637.0 ± 5.0
Gauze swab	Plain weave	255.1 ± 3.8

Results: Figure 1 shows that the relative cell proliferation rate compared to the standard well plate was greater than 100% for both samples. This means that neither sample is cytotoxic. During rabbit and guinea pig animal testing, neither erythema nor edema were observed around the skin test site. This confirms good biocompatibility.

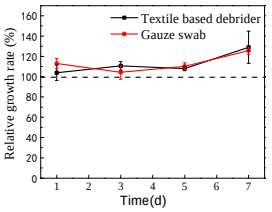

Figure 1. Relative growth rate of cells for textile packing material and gauze swab.

Other test results are shown in Table 3, from which we can see that the textile packing material has a better performance than the commercial gauze swab in terms of liquid absorption capacity, tensile and bending strengths. For the dry friction test and the wet sonic oscillation test, the difference in the results is not significant.

Table 3. Different test results

	Textile Packing Material	Gauze Swab
LAC (%)	1059.6±36.4	720.6±7.7
Loss of weight ($mg/100cm^2$)	1.12±0.11	1.02±0.13
Number of shed fibers/particles	6.63±0.58	7.33±1.53
Tensile force (N)	200.9 ± 3.7	62.8 ± 1.9
Compression force (cN)	32.03±2.46	--
Flexural rigidity (mN.cm)	13.53±2.32	23.36±1.85

Conclusions: In summary, the selected methods provided a practical protocol for characterizing the functional properties of packing materials. In the future a comprehensive index, which includes the weight of each property, will be explored. In addition, further work will be required to establish the relationship between the objective test methods and the subjective evaluation by nursing staff and rehabilitation therapists.

References:

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