Comparative Study between Chitin/Polyacrylic Acid (PAA) Dressing, Lipido-Colloid Absorbent Dressing and Alginate Wound Dressing: A Pilot Study in the Treatment of Partial-Thickness Wound

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Background: *Polyacrylic acid grafted chitin (Chitin-PAA) contains a hydrogel characteristic that makes it more suitable for wound dressing application. In animal models, Chitin-PAA dressing exhibited properties as a promising dressing. Epithelization promotion, rapid reduction of wound size, reduction of inflammatory cell response, and less toxicity had been noted.*
Objective: *Carryout a pilot clinical comparative study of Chitin-PAA dressing, lipido-colloid absorbent dressing, and alginate wound dressing in the treatment of partial-thickness wound.*
Material and Method: *Between June 2006 and March 2007, 36 partial-thickness wounds were randomized into three groups and three different types of dressing were used. Each wound was treated until it was completely healed, and a visual analogue scale was used for the pain evaluation.*
Result: *The present study shows the visual analogue pain score in the Chitin-PAA group seems to be a bit higher than the Urgocell® group but not statistically different. The completely healed day is not significantly different. Three patients in the lipido-colloid absorbent dressing groups had wound infection but eventually healed after treatment.*
Conclusion: *There was no statistical difference in terms of visual analogue pain score and healing time between the lipido-colloid absorbent dressing, alginate dressing, and chitin-PAA dressing.*

Keywords*: Polyacrylic acid, Chitin, Chitin PAA, Alginate dressing, Lipido-colloid absorbent dressing, Wound healing, Partial-thickness wound*

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Wound healing is a complex process that includes inflammatory proliferation and remodeling phase. Nowadays, there are many wound dressing materials commercially available for treatment for all different types of wound.

Chitin is an organic material easily prepared from the shells of crab, shrimp, and squid. Chitin, grafted with polyacrylic acid [chitin-PAA], was prepared with the aim of obtaining a hydrogel characteristic for wound dressing application[1-3]. The physiochemical properties of chitin-PAA were previously investigated and have shown a capability of absorbing water 30-60 times of their original weights while maintaining their integrity[1].

Previous animal study had shown that Chitin-PAA had expressed a biocompatible property in the rat model. Normal liver and kidney function tests and normal organ's weight after topical application of these biomaterials indicated that neither local nor systemic effect from these materials interfered with vital organ function. The other animal study had

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demonstrated that the Chitin-PAA dressings exhibited suitable properties of ideal dressing such as rapid re-epithelialization, increased wound healing rate by showing rapid reduction of the wound size, reduced inflammatory cells, and less toxicity.

The present pilot study was to compare Chitin-PAA dressing, lipido-colloid absorbent dressing, and alginate wound dressing in the treatment of partial-thickness wound.

Material and Method

After obtaining informed consent and approval from King Chulalongkorn Memorial Hospital Ethic Committee, between June 2006 and March 2007, 36 partial-thickness wounds were enrolled in the present study. The enrolled patients had an average age between 20 and 70 years. Exclusion criteria were allergy to seafood, DM, and other dermatologic and chronic diseases.

Patients were randomized to one of the three groups, using three different types of dressing materials. Group 1 was treated with lipido-colloid absorbent dressing (Urgocell®), group 2 with alginate wound dressing (Algisite M®), and group 3 with Chitin-PAA dressing, which is developed by National Metal and Materials Technology Center (MTEC), Thailand. After the partial-thickness skin graft was harvested with 10-12/1000 inches thickness from the donor site on the anterior surface of the thigh, the material was applied over the wound. The outer layer was dressed as needed.

Patients were asked to assess their pain score at the first, second, and third postoperative day. The score was based on the visual analog score scale from 1 to10 points. The completely healed day and other adverse events were recorded. The completely healed wound was recorded on the day that the dressing material was easily removed.

Data from the three groups were compared by using the Kruskal Wallis test and a p-value < 0.05 is statistically significant.

Result

The demographic data of the three groups were similar as shown in Table 1.

Pain scores at the first, second and third post-operative day among the three groups were not significantly different (Fig. 1).

The completely healed days were not significantly different among the three groups ($p = 0.149$), the mean is 12.18 days (Fig. 2).

Table 1. Demographic data

	Urgocell®	Algisite M®	Chitin-PAA
No. of patient	12	12	12
Mean age	30.25±10.04	29.14±12.85	31.15±10.58
Male	6	5	8

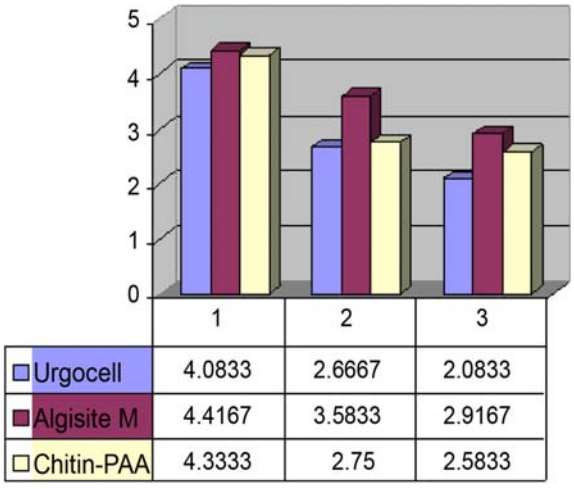


Fig. 1 Comparison of postoperative pain in 3 days among 3 groups

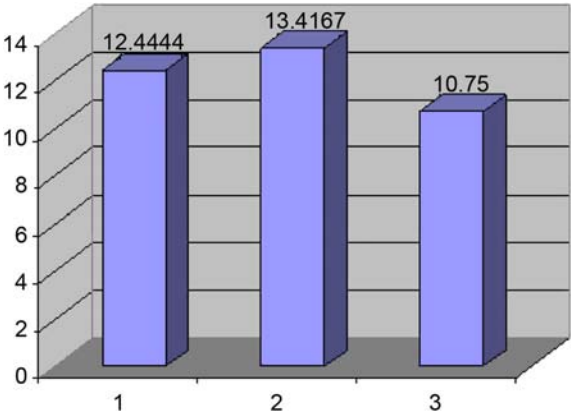
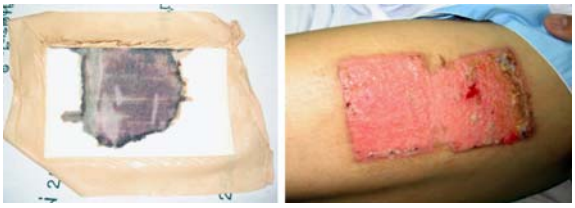


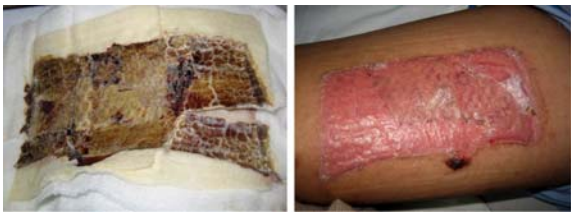
Fig. 2 Comparison of the completely healed day among the three groups (Urgocell (1), AlgisiteM (2), Chitin-PAA (3)

Discussion

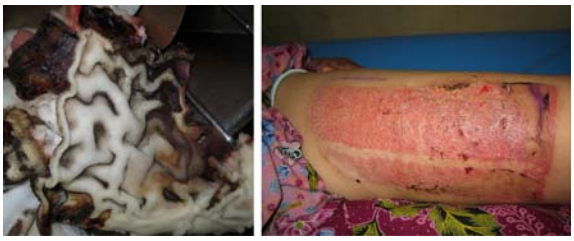
The present study was to compare the efficacy of alginate and chitin grafted with polyarylic (chitin PAA), which are both bioactive products. The



Urgocell® group



Algisite M® group



Chitin-PAA group

Fig. 3 Illustration of wounds treated with different types of dressing

lipido-colloid absorbent dressing is classified in the hydrocolloid group. Healing at the partial-thickness skin graft donor sites was used as a model to test the efficacy of these wound-dressing materials[9].

Lipido-colloid absorbent dressing (Urgocell®) is a semi-permeable, adhesive absorbent dressing made up of three layers. The non-adherent lipido-colloid interface is in contact with wound (polymer matrix-carboxymethyl cellulose particles and Vaseline). An absorbent polyurethane foam pad is placed in the middle of the dressing. The outer layer is a protective polyurethane backing coated with an adhesive.

In contact with wound exudates, the hydro-colloid particle gel combines with the matrix to form a lipido-colloid film.

Alginate wound dressing (Algisite M®) is a calcium alginate dressing consisting of thick, highly-absorbent of non-woven alginate fibers. The bonding process minimizes fiber shed and enhances physical strength of the dressing in the wound. When alginate absorbs wound exudates, sodium ions from the exudates replace calcium ions in the alginate. This allows the fibers to absorb the exudates and become a gel.

The biocompatible chitin and its derivatives have been used worldwide for a variety of applications such as paper, food, cosmetics[3,4,6-8]. Many types of chitin-based materials have been used for wound dressing application[10-12]. However, low water absorption ability of chitin yields an inefficient exudates removal from the wound surface. Grafting of various monomers containing hydrophilic groups onto chitin chains is the method to enhance its water absorption ability[1,2,5].

Chitin grafted with polyacrylic acid (Chitin-PAA) has been developed to improve this disadvantage. It has increased the absorption ability to 30-60 times of its original weight while maintaining integrity. Chitin-PAA has shown no signs of allergenicity or any high inflammatory response in wound study using a rat model[1].

The Urgocell® and Algisite M® are both commercial products. The Chitin-PAA is not commercially available.

The present study shows that the pain score were not statistically different among these three groups. However, the visual analogue pain score in the Chitin- PAA group seems to be a bit higher than the Urgocell® group. The completely healed day is not significantly different. Three patients in the lipido-colloid absorbent dressing groups had wound infection but eventually healed after treatment.

In summary, there was no statistical difference in terms of visual analogue pain score and healing time among the lipido-colloid absorbent dressing, alginate dressing and chitin-PAA dressing.

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การศึกษาเปรียบเทียบระหว่างการใช้ chitin/polyacrylic acid (PAA), lipido-colloid absorbent dressing และ alginate รักษาบาดแผลที่มีหนังแท้เหลืออยู่บางส่วน

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Polyacrylic acid grafted chitin (Chitin-PAA) ประกอบด้วย hydrogel ซึ่งมีลักษณะเฉพาะตัว ทำให้มีความเหมาะสมสำหรับใช้เป็นวัสดุทำแผล ในการศึกษากับสัตว์ทดลองพบว่า Chitin-PAA dressing มีคุณสมบัติเป็นวัสดุทำแผลที่พัฒนาขึ้นมาตามความต้องการโดยพบว่าทำให้มี epithelialization เพิ่มขึ้น แผลมีขนาดลดลงอย่างรวดเร็ว, ลดการตอบสนองของเซลล์ที่ทำให้มีการอักเสบ และมีความเป็นพิษน้อยกว่า ผู้นิพนธ์ได้ทำการศึกษานำร่องทางคลินิก เพื่อเปรียบเทียบระหว่าง Chitin-PAA, วัสดุทำแผลชนิด lipido-colloid ชนิดที่สามารถดูดซับน้ำเหลืองได้และ alginate ในการรักษาบาดแผลที่มีหนังแท้เหลืออยู่บางส่วนระหว่างเดือนมิถุนายน พ.ศ. 2549 ถึงเดือนมีนาคม พ.ศ. 2550 โดยทำการศึกษากับบาดแผลทั้งหมด 36 แผล ซึ่งมีการแบ่งกลุ่มแบบสุ่มเป็น 3 กลุ่ม และใช้กับวัสดุทำแผล 3 ชนิด ทำการรักษาแผลแต่ละแผลจนหายสนิทและได้มีการใช้ visual analogue scale สำหรับประเมินความเจ็บปวด ผลการศึกษาแสดงว่าไม่มีความแตกต่างกันอย่างมีนัยสำคัญในอัตราการหาย หรือความเจ็บปวดในผู้ป่วยแต่ละกลุ่มในช่วงระยะเวลา 3 วันแรกหลังผ่าตัด