



## 健康科學院 107 學年度畢業生研究成果發表會 議程

日 期：108 年 6 月 14 日（星期五）

地 點：耕書樓 (B1) 順之廳

| 時間           | 項目        | 主持人          | 活動內容                                                                                                                     |
|--------------|-----------|--------------|--------------------------------------------------------------------------------------------------------------------------|
| 07:50-08:10  | 報到        | 醫技系<br>楊珮瑤助理 | 畢業生至壁報前就定位                                                                                                               |
| 08:10-09:00  |           |              | 參加人員簽到、領取資料                                                                                                              |
|              | 壁報評選      | 評審委員         | 畢業生於壁報旁備詢                                                                                                                |
| 09:00-09:10  | 開幕式       | 潘銘正院長        | 院長暨貴賓致詞                                                                                                                  |
| 第 1 場 論文口頭發表 |           |              |                                                                                                                          |
| 09:10-09:40  | 醫放博士班     | 生醫所<br>李孟娟老師 | 磁振造影多波序列對未顯影肝血管瘤之研究<br>陳文昌/指導教授：林松水                                                                                      |
| 09:40-09:55  | 醫技系       |              | 薑黃素對腦缺血之大腦皮質氧化性壓力、抗氧化酵素活性與微量元素黃郁恩/指導教授：林明政                                                                               |
| 09:55-10:10  | 醫放系       |              | 利用田口最佳化評量心導管攝影之影像品質中的最低可偵測極限<br>陳科霖/指導教授：潘榕光                                                                             |
| 10:10-10:25  | 牙技系       |              | 添加氧化鋁對 MgO-CaO-Al <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub> -P <sub>2</sub> O <sub>5</sub> 生物活性玻璃之影響<br>胡嘉維/指導教授：吳世經 |
| 10:25-10:45  | 中場休息/茶敘時間 |              |                                                                                                                          |
| 第 2 場 論文口頭發表 |           |              |                                                                                                                          |
| 10:45-11:00  | 環安系       | 醫技系<br>蕭懿民老師 | 寺廟大氣中焚香之醛酮類化合物與重金屬成分特徵分析<br>項堯楷/指導教授：賴嘉祥                                                                                 |
| 11:00~11:15  | 生醫所       |              | 黑腐病菌 <i>clpX</i> 之特性<br>李芷恩/指導教授：蕭懿民                                                                                     |
| 11:15~11:30  | 中場休息      |              |                                                                                                                          |
| 11:30~11:50  | 頒獎        | 論文壁報暨口頭發表    |                                                                                                                          |
| 11:50-12:10  | 綜合座談      | 潘銘正院長        |                                                                                                                          |
| 12:10        | 賦歸        |              |                                                                                                                          |



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## 槲皮素對腦缺血大鼠之大腦皮質脂質過氧化作用、抗氧化酵素活性與 微量元素之效應

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### 摘要

根據衛生福利部統計，腦中風在台灣人口十大死因中排行第四名。研究顯示，腦中風不只會產生有毒的自由基，還會導致進一步的氧化應激和腦損傷，從而造成大腦氧化壓力的產生並導致氧化性損傷。先前的研究指出，大腦需要適當濃度的微量元素和抗氧化酶活性才能維持正常的新陳代謝。槲皮素屬於黃酮類化合物，在許多蔬菜水果中都可見到，例如：洋蔥、蘋果等食物中。先前的研究顯示，槲皮素具有多種有益於人體的功能，如神經保護，抗炎，抗過敏，抗腫瘤和抗氧化。目前為止，尚未充分討論槲皮素對腦缺血損傷中微量元素，抗氧化活性和脂質過氧化的影響。我們的實驗結果顯示，腦缺血前給予大鼠槲皮素可有效提高超氧化物歧化酶（SOD），觸酶（CAT）和鎂（Mg），鋅（Zn）和硒（Se）的微量元素水平的抗氧化活性。此外，在槲皮素處理組中發現槲皮素能有效降低脂質過氧化和微量元素鐵（Fe），銅（Cu），鉛（Pb），砷（As），鉻（Cr），鋁（Al）的濃度。綜合上述的結果，我們認為，槲皮素的神經保護機制可能與降低缺血性大腦皮質的脂質過氧化狀態，提高抗氧化酶活性和改變微量元素濃度密切相關。

**關鍵字：**腦缺血、抗氧化酵素、微量元素、脂質過氧化作用、槲皮素



## **Effects of Quercetin on Lipid Peroxidation, Antioxidant Enzyme Activity, and Trace Element Levels in the Ischemic Brain Cortex of Rats**

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### **Abstract**

According to the report from the Ministry of Health and Welfare, strokes ranked fourth among the top ten causes of death in Taiwan. Studies have shown that stroke not only generates toxic free radicals but also results in further oxidative stress and brain damage. Previous studies have pointed out that proper trace element level and antioxidant enzyme activity are required for the brain for maintaining their normal metabolism. Quercetin is a flavonoid compound mainly existed in many fruits and vegetables such as onions and apples. Previous investigation has revealed the fact that quercetin possessing a variety of beneficial functions such as neuroprotection, anti-inflammation, anti-allergic, anti-tumor, and anti-oxidation. So far, quercetin has not been fully discussed about its influence on the changes of trace elements, antioxidant activity and lipid peroxidation during cerebral ischemic insult. Our experimental results show that administration of rats with quercetin prior to cerebral ischemia can effectively increase antioxidant activity of superoxide dismutase (SOD), catalase (CAT), and trace element level of magnesium (Mg), zinc (Zn), and selenium (Se). Furthermore, reduced lipid peroxidation intensity and declined trace element concentration of iron (Fe), copper (Cu), lead (Pb), arsenic (As), chromium (Cr), and aluminum (Al) was found in quercetin-treated subject. Taking all observation together, it seems possible to conclude here that neuroprotective mechanism of quercetin is closely associated with declining lipid peroxidation status, elevating antioxidant enzyme activity, and altering trace element level on the ischemic brain cortex.

**Keywords :** cerebral ischemia, lipid peroxidation, antioxidant enzyme, trace elements, quercetin



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## 薑黃素對腦缺血之大腦皮質氧化性壓力、抗氧化酵素活性與微量元素之效應

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### 摘要

由世界衛生組織提出的證據顯示，中風是美國、加拿大和台灣等已開發國家老年人口中最常見的死亡原因。先前的研究也提出，腦缺血不僅會促進活性氧自由基 (ROS) 的產生，更導致大腦進一步的氧化性損傷。適當的微量元素濃度和抗氧化酵素活性對維持大腦功能被證實是重要的。過去研究指出薑黃素對神經保護、心血管保護、抗氧化和抗發炎方面具良好的效應，而本研究的目的是試圖闡明薑黃素對缺血性大腦的神經保護機制。透過右側大腦中動脈 (MCA) 及右頸總動脈 (CCA) 的結紮手術誘導腦缺血 1 小時。實驗結果顯示，腦缺血手術之前給予薑黃素不僅顯著降低脂質過氧化濃度，還可以降低微量元素包括：鐵 (Fe)、銅 (Cu)、鉛 (Pb)、鋁 (Al)、鉻 (Cr) 和砷 (As) 的濃度。相反的，抗氧化酵素活性如：過氧化氫酶 (CAT)、超氧化物歧化酶 (SOD) 與微量元素鎂 (Mg)、鋅 (Zn) 和硒 (Se) 的濃度皆顯著上升。針對本研究結果，似乎可以提出薑黃素在缺血性大腦的神經保護機制與提高抗氧化酵素活性，降低脂質過氧化和微量元素濃度的改變有高度相關。

**關鍵字：**腦缺血、氧化壓力、抗氧化酵素、微量元素、薑黃素



## **Effect of Curcumin on Oxidative Stress, Antioxidant Activity, and Trace Element in Cerebral Ischemic Brain Cortex**

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### **Abstract**

Recent evidence from World Health Organization has proposed that stroke is the most commonly cause of death in older populations of the developed countries such as United States, Canada, and Taiwan. Previous studies have suggested that cerebral ischemia not only can promote the generations of reactive oxygen species (ROS) but also can lead to further oxidative damage. It has been well-recognized that appropriate trace element level and antioxidant enzyme activity is important for the brain function. Curcumin exerts beneficial effects in neuroprotection, cardiovascular protection, anti-oxidation, and anti-inflammation has been previously evidenced. The aim of this present thesis attempted to elucidate precisely neuroprotective mechanism of curcumin on the ischemic brain. Cerebral ischemia was induced via occlusion of the right middle cerebral artery (MCA) and right common carotid artery (CCA) for one hour. Curcumin-treated rat was given curcumin prior to cerebral ischemic surgery. Data showed that pretreatment rats with curcumin not only can significantly reduce lipid peroxidation level but also can decline trace element concentration such as iron (Fe), copper (Cu), lead (Pb), aluminum (Al), chromium (Cr) and arsenic (As). In contrast, antioxidant activity of catalase (CAT), superoxide dismutase (SOD), and trace element level of magnesium (Mg), zinc (Zn), and selenium (Se) were increased in curcumin treated rats. Accordingly, it seems possible to proposed our findings here that neuroprotective mechanism of curcumin is highly correlated with elevating antioxidant enzyme activity, declining lipid peroxidation status, and changing trace element concentration on the ischemic brain.

**Keywords :** cerebral ischemia, oxidative stress, antioxidant enzymes, trace elements, curcumin



## 混摻蛋黃油親水性高分子薄膜敷料之製備及體外試驗評估

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### 摘要

本研究探討聚乙炔吡咯烷酮/明膠/幾丁聚醣/混摻蛋黃油(EYO) 透過戊二醛蒸氣交聯製備複合薄膜(簡稱 PGC/EYO 薄膜)，評估具不同濃度蛋黃油的薄膜其機械性質、降解度及對老鼠成纖維母細胞(L929 cell line)的增殖表現。從拉伸試驗結果，可知混摻蛋黃油後之薄膜其機械性質整體提升，其中 PGC/0.5EYO 薄膜具有較佳的延伸率。混摻蛋黃油之比例於含水率及膨潤度及降解度均有其影響，其中以 PGC/0.25EYO 薄膜最為顯著。由 ATR-FTIR 分析可見因添加蛋黃油而產生新的波峰分別在 1744 及 2926cm<sup>-1</sup> 處。蛋油微粒於高分子薄膜情形由 FE-SEM 觀察，以 PGC/0.5EYO 最為顯著。體外細胞實驗中除了 PGC/0.5EYO 之外，其他薄膜對於 L929 細胞具有抑制增殖的作用，評估後 PGC/0.5EYO 具有較佳的機械性質、合適的降解性質及細胞相容性，對於放射性皮炎之修復具研究發展潛力。

**關鍵字：**幾丁聚醣、明膠、聚乙炔吡咯烷酮、薄膜、蛋黃油



## Evaluation of Preparation for the Film of Hydrophilic Polymer Blended with Egg Yolk Oil and In-vitro Test

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### Abstract

In this study, we investigated the preparation of composite films of polyvinyl pyrrolidone/gelatin/ chitosan blend with egg yolk oil (EYO) (called PGC/EYO) which cross-linked by glutaraldehyde (GA) vapor, and evaluated biocompatibility in vitro by the PGC film with the different concentrations of EYO. Analyzing the mechanical properties, cross-linking degree, and proliferation of L929 mouse fibroblast cell line of PGC/EYO film. From the tensile test results, it is known that the mechanical properties of the film blended with EYO increased overall, among which PGC/0.5EYO has the best percent elongation. The weight ratio of the EYO affect the water content rate, swelling ratio, and degradation rate to the film, among which the PGC/0.25EYO film present significantly. According to ATR-FTIR, that the new peaks due to blend with EYO are 1744 and 2926 cm<sup>-1</sup>, respectively. The distribution of egg-oil-microparticles in the polymer films were observed by FE-SEM, and PGC/0.5EYO was the most significant. In vitro, The PGC/EYO films inhibit proliferation of L929 cells except for PGC/0.5EYO. The most ideal film by the overall evaluation was PGC/0.5EYO. The film has the potential and development for wound healing of radiation dermatitis.

**Keywords :** chitosan, gelatin, polyvinyl pyrrolidone, film, egg yolk oil



## 利用田口最佳化評量心導管攝影之影像品質中的最低可偵測極限

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### 摘要

心導管檢查是利用特製不透光導管經由大腿股動脈或手腕的週邊動脈將導管伸入心臟的冠狀動脈內，然後注射顯影劑，再利用 X 光透視來檢視心臟血管血流狀況、病變位置及嚴重程度。心導管檢查是目前診斷冠狀動脈疾病最準確的方法。

在本次研究中，將利用田口分析方法利用線對塊規假體與固態水假體進行心導管 X-ray 的照射，來評量各個參數設定的最佳化條件。實驗使用田口 L8 直交表進行 8 組不同參數條件的照射，設定四個可變因子，分別為 (A) 焦點大小 (focus)；(B) 管電壓 (kVp)；(C) 管電流與時間乘積 (mAs)；(D) 射源至影像接受器的距離 (SID)；每個可變因子均設定兩個 (低和高) 水準。通過 X-ray 照射後得到影像，再由三名資深放射師或放射醫師依雙盲法進行打分評定。實驗採用高對比、低噪聲、高精度的標準對線對假體給出評分。然後對該評分利用修正後的學生 t 檢定進行分析，推導出 MDD 來表示 X 射線圖像的空間解析度。在整個實驗中，確定了最佳解析度組合，並進行臨床驗證。

實驗的最後，臨床設定、第 7 組 (在八標組合中最高評分) 和最佳設定計算得出的 MDD 值分別為 0.183、0.167 和 0.157 mm，對比與線對假體所對應的刻度 (LP/mm) 分別為 2.7、3.1 和 3.2 LP/mm。

由這次實驗可以看出，田口分析方法是研究心導管 X-ray 最低可偵測極限解析度的較好的方法，並且再與 t 檢定配合研究，可以有效提高影像解析度。

**關鍵字：**田口分析方法、t 檢定、最低解析度



## Optimizing the Minimum Detectable Difference of Cardiac X-ray Imaging Quality Using the Taguchi analysis and a Precise Line Pair Gauge

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### Abstract

To optimize the minimum detectable difference (MDD) of a cardiac X-ray imaging system using the Taguchi  $L_8(2^7)$  analysis and a precise line pair gauge.

The optimal combination of the four critical factors of the cardiac X-ray imaging system, namely X-ray focus, kilovoltage (kVp), milliamper-seconds (mAs), and source image distance (SID), providing the minimum detectable difference (MDD) was calculated via the Taguchi analysis and experimentally verified. Two (low and high) levels were assigned for each factor, and eight combinations of four factors were used to acquire instant X-ray images using an NDT commercial line pair gauge (with a gauge length of 64 mm and a width of 3.5 mm). The latter had five lines and was split gradually from top to bottom for the inspection of X-ray images, which quality was ranked by three well-trained radiologists according to the double-blind criterion. The ranking grade was given by sharp contrast, low noise, and precision to distinguish the line pair. Accordingly, the MDD was derived to represent the spatial resolution of instant X-ray images by the revised Student's t-test analysis. The optimal combination of factors was experimentally identified and clinically verified in the follow-up inspections.

For the conventional setting, Group No.7 (which obtained the highest grade among eight groups), and the optimal setting, the obtained MDD values were 0.183, 0.167, and 0.157 mm, , respectively, while the line pair (line pair/mm) interpolated from the gauge scale amounted to 2.7, 3.1, and 3.2 LP/mm, respectively.

The Taguchi  $L_8$  analysis was proved to be instrumental in optimizing the cardiac X-ray imaging system MDD and is recommended to be used jointly with the revised Student's t-test analysis for improving the spatial resolution of instant X-ray images.

**Keywords :** Taguchi analysis , Student's t-test , MDD



## 以空間矩陣法探討透視攝影機空間輻射劑量分佈

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### 摘要

原能會於 2018 年進行透視品保的工作，在透視下醫師無可避免的將接受到輻射劑量，但其劑量多寡，可因其所站立位置、使用不同儀器操作及輻射劑量條件組合而有所不同。如果能知道在透視檢查室內，哪一個矩陣空間在進行透視攝影時，其所遭受到的輻射劑量最高並提供一個友善的等劑量曲線，可使包括醫師在內的醫事人員安心的保障，將是一個重要的課題。本實驗以醫院 angio-room X 光機來進行，將熱發光劑量計(TLD)置入已編號的夾鏈袋中並懸吊於細繩上，此細繩兩端連接並用旗桿來當作支撐點固定，而 TLD 位置的佈點將以 X 光中心射束為中心軸，設定長 300 公分、寬 180 公分的平面空間，以每 30 公分為一個間隔來放置 TLD，再分別以 85、95、125、155 以及 180 公分高作量測，如此將可形成一個立體空間的劑量分布曲線。為了增加在臨床上醫療技術人員有可能會帶來的散射劑量，在本實驗設置了三個假人並穿上鉛衣來模擬散射情形。讀取熱發光劑量手動參數劑量，觀察 5 分鐘透視攝影的平均劑量，由下往上分五層分別測得的劑量結果為  $1.46 \pm 0.45$  mGy、 $1.54 \pm 0.96$  mGy、 $2.12 \pm 0.82$  mGy、 $1.42 \pm 0.56$  mGy、 $1.36 \pm 0.38$  mGy。

**關鍵字：**透視劑量、空間矩陣、熱發光劑量計



## Evaluation of Radiation Dose Distribution on Fluoroscopy

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### Abstract

Originally, in the year of 2018, the work of seeing the quality assurance will be carried out. Under the perspective, the physician will inevitably receive the radiation dose, but the dose may be due to the position of the standing, the use of different instrument operations and the combination of radiation dose conditions. Different. If you know which matrix space in the fluoroscopy room is performing fluoroscopy, the radiation dose is the highest and provides a friendly isodose curve, so that the medical staff, including the physician, can be assured of peace of mind. An important topic. The experiment was performed with a hospital angio-room X-ray machine. The thermal illuminating dosimeter (TLD) was placed in a numbered zipper bag and suspended from a string. The ends of the string were connected and supported by a flagpole. The point is fixed, and the position of the TLD position will be centered on the X-ray center beam, and a plane space of 300 cm in length and 180 cm in width is set, and the TLD is placed at intervals of 30 cm, and then 85, 95, and 125, respectively, 155 and 180 cm high measurement, this will form a three-dimensional space dose curve. In order to increase the amount of scattering that medical technicians are likely to bring in the clinic, three dummies were placed in this experiment and lead clothing was put on to simulate the scattering situation. Read the manual dose of the thermal illuminating dose and observe the average dose of fluoroscopy for 5 minutes. The doses measured from the bottom to the top are respectively  $7.48 \pm 0.45 \text{ mGy}$ 、 $7.67 \pm 0.96 \text{ mGy}$ 、 $8.98 \pm 0.82 \text{ mGy}$ 、 $7.39 \pm 0.56 \text{ mGy}$ 、 $7.27 \pm 0.38 \text{ mGy}$ .

**Keywords :** fluoroscopy, spatial matrix, TLD



## 利用自製壓克力假體定量分析與比較四種商業化的

### 金屬假影抑制技術

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#### 摘要

研究重點是用自製壓克力假體進行定量分析，並比較四種商業化金屬假影抑制 (MAR) 技術使用於三種常見金屬植入物在電腦斷層掃描 (CT) 中的效果。

製作一個中間有凹槽的圓柱形假體，並在凹槽中分別放置三種類型的金屬植入物：髖關節植入物，脊柱植入物和牙齒填充物。通過四個 CT 掃描儀掃描假體，並使用四種商業化的 MAR 技術來分析圖像。這四種技術是單能量金屬假影抑制 (SEMAR, Canon)、智能金屬假影抑制軟體 (Smart-MAR, GE)、疊代金屬假影抑制 (IMAR, Siemens)，以及外科植入物的金屬假影抑制 (OMAR, Phillips)。定量分析方法包括兩名放射科醫師和一名放射線技師的主觀分析和 2 種主觀分析。最後評估了四種 MAR 技術的品質因數(Figure of merit)以進行比較。

SEMAR、Smart-MAR、IMAR 和 OMAR 的預期值分別為 36.6, 37.8, 5.0 和 2.3。定量分析證實，四種 MAR 技術成功的減少了三種金屬植入物的金屬假影；然而，由於含高密度材質，牙齒填充物的效果較不顯著。

Canon 的 SEMAR 和 GE 的 Smart-MAR 在四種 MAR 技術中有最佳的主觀和客觀分析結果。

**關鍵字：**電腦斷層攝影、金屬假影抑制技術、定量分析



## Comparison of Quantitative Measurements of Four Manufacturer's Metal Artifact Reduction Techniques with a Self-made Acrylic Phantom

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### Abstract

**Purpose:** The research focused on a self-made acrylic phantom to conduct quantitative analysis and compare the effectiveness of using computed tomography (CT) scans that applied commercial metal artifact reduction (MAR) techniques on three types of metal implants.

**Material and Methods:** A cylindrical phantom with a groove in the middle was made and placed three types of metal implants in the groove: hip implants, spinal implants, and dental fillings. The phantom was scanned by four CT scanners and four commercialized MAR techniques were used to analyze the images. The four techniques were single-energy metal artifact reduction (SEMAR, Canon), smart metal artifact reduction software (GE), iterative metal artifact reduction (Siemens), and metal artifact reduction for orthopedic implants (Philips). Quantitative analysis methods included objective and subjective analysis with two radiologists and one radiographer. The figure of merit for four MAR techniques were evaluated for comparison.

**Results:** The expected value of SEMAR, Smart-MAR, IMAR, and OMAR are 36.6, 37.8, 5.0, and 2.3, respectively. Quantitative analysis verified that four MAR techniques reduced metal artifacts from three types of metal implants; however, the effect was not significant with dental fillings due to high density material.

**Conclusion:** SEMAR of Canon and Smart-MAR of GE achieved optimal subjective and objective analysis results for the three types of metal implants among four MAR techniques.

**Keywords :** computed tomography, metal artifact reduction, quantitative analysis



## 應用田口動態分析最佳化電腦斷層數與質量的線性相關

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### 摘要

本研究是利用田口方式分析標準化電腦斷層數與質量密度的線性相關，我們利用田口獨有 18 標直交表的動態分析一個商業用 Cataphan 600 假體合併 CTP404 模組，用來標準化由六個電腦斷層控制因子，包含掃描時間、電流量、管電壓、視野大小、切面厚度及影像處理流程。每個因子都被賦予二到三個不同的標準以符合田口 18 標的組合要求，用田口動態理論分析七種被放入假體不同的密度的物質，而修飾過的訊號音訊比值被用來描述各種嵌入因子的表現以追求理想的電腦斷層數(HU)修正曲線。最佳的組合包含一秒的掃描時間，130kVp 的管電壓，40 平方公分的照野大小，3 公分的切面厚度，軟式影像處理流程。管電壓和照射視野為最重要的影響因子，經過最佳化處理過後相關係數由 0.9755 上升至 0.9954。這個最佳化的組合成功的經過臨床 Rando 假體模擬口腔癌患者驗證，The well-calibrated 當照射劑量超過 7000cGy 最佳化設定及原始的設定等位劑量曲線會有最大差異，而小於 5000cGy 差異相似。

**關鍵字：**田口、動態分析、假體、質量、電腦斷層數



## Taguchi Dynamic Analysis Application to Computer Tomography Number-mass Density linear Dependence Optimization

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### Abstract

The Taguchi dynamic analysis was applied to optimize the linear dependence between computer tomography (CT) number and mass density. The Taguchi unique L18( $2^1 \times 3^5$ ) orthogonal array was utilized in the dynamic analysis of a commercial Catphan 600 phantom with CTP 404 module, in order to optimize eighteen combinations of six factors controlling the CT simulator operation, i.e. scan time, kVp, mA, field of view (FOV), slice thickness, and imaging processing algorithm. Each factor being assigned two or three different levels made it possible to organize the required number of combinations (18). The seven materials involved in the phantom possessed different mass densities, which were incorporated into the dynamic analysis. The revised signal-to-noise ratio (S/N) was utilized to describe the integrated performance of various factors' combinations in pursuing the optimal  $\rho$ m-CT number (HU) calibration curve. The optimal option was found to be: 1 s scan time, 130 kVp, 200 mA, 40 cm<sup>2</sup> FOV, 3 cm of slice thickness, and soft type of algorithm for maintaining the  $\rho$ m-HU calibration. Factors kVp and FOV dominated the performance either by providing a significant change in S/N value or strongly improving the reproducibility in daily quality assurance. The  $\rho$ m-HU calibration ( $HU = 1016.9 \times \text{density} + 1029.5$ ,  $r^2 = 0.9954$ ) was further verified by the treatment planning systematic default (TPS) ( $HU = 1242.1 \times \text{density} + 1054.8$ ,  $r^2 = 0.9755$ ). The well-calibrated  $\rho$ m-HU curve was successfully applied to clinical examination of the simulated oral cancer from CT scanned slice via a Rando phantom. A significant disagreement between optimal and default isodose curves was observed for doses exceeding 7000 cGy, while a good fit was exhibited by doses below 5000 cGy.

**Keywords :** Taguchi, dynamic analysis, phantom, mass density, CT number



## 利用改良的泰勒級數展開式應用於第 0 至 4 期的乳癌患者在有無放射

### 治療的存活率預測：台灣的人口研究

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#### 摘要

乳癌在世界各國發生率是相當高的，特別是在過去十年中，台灣已有數萬名女性被確診為乳癌患者。

藉由乳癌在不同的（0-IV）期別的存活率及提供乳癌在有無放射治療成效的有效評估。

以大數據資料，以數學式中改良的泰勒式展開法詮釋乳癌患者在有無放射治療各期別存活率，此法不同於以往 5 年存活率。利用致死頻率 $[\alpha, yr-1]$ （即存活率 $= \exp(-\alpha t)$ ），討乳癌病人在有無放射治療存活率的變化及利用泰勒展開式公式的特性得預測對放射治療的正面反應。把乳癌患者死亡當作放射線核種的活性衰變，存活率曲線就可以已放射線核種的活性衰變來對待，把此方法應用在癌症登記乳癌患者資料解讀上非常適當。不但符合病理發展趨勢，也藉由 Taylor expansion 的幫助把存活率做具體的解釋及應用。

在有接受放射治療的 0-4 期乳癌病人中，其致死頻率分別為{0.0029, 0.0066, 0.0178, 0.0475, 0.1785};反之在無放射治療的 0-4 期乳癌病人中，其致死頻率分別為{0.0072, 0.0137, 0.0264, 0.0913, 0.2425}。在乳癌第二期患者無放射治療平均餘命為 37.8 年，有放射治療增加為 56.3 年;第三期患者無放射治療平均餘命為 11.0 年，有放射治療平均餘命為 21.0 年，意謂接受放射治療是可以增加平均餘命的，但第四期就無明顯差別。

根據修正後的泰勒級數展開式，提出了一個預測乳癌患者不同期別存活率的修正算法。該算法可以通過將額外接受治療中來提高預測生存率的準確性。乳癌



患者接受放療或未接受放療的四種恢復方式均遵循 hit-Target 模型。shoulder effect 意味著對治療的良好反應;從而提高了成活率。

**關鍵字：**全死因死亡率、乳癌、泰勒擴展演算法、靶核理論模式、致死頻率



## **Survival Rate Prediction of Breast Cancer Patients of 0-IV Stages with and without Radiotherapy via a Revised Taylor Series Expansion Algorithm: A population-based Study in Taiwan**

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### **Abstract**

The morbidity of breast cancer has continuously achieved a global topicality. In particular, during the last decade several ten thousand female adults in Taiwan have been confirmed as breast cancer patients.

To predict the survival rate of breast cancer patients at various (0-IV) stages and provide efficient assessment of proposed radiotherapy for patients.

The prediction algorithm proposed is based on the revised hit and target model and implies the application of Taylor series expansion to the population-based survey dataset. The proposed algorithm features a specific function comprising a single simple exponential term  $\exp(-\alpha t)$  to imply the fundamental degradation of patient's health multiplied by an additional term  $P(\alpha t)$ , which specifies the recovery effect of a particular therapy.

Its calculated values for breast cancer patients who undergone radiotherapy at different stages 0-IV were {0.0029, 0.0066, 0.0178, 0.0475, 0.1785}  $\text{yr}^{-1}$ , respectively, while those for corresponding groups of patients with no radiotherapy were assessed as {0.0072, 0.0137, 0.0264, 0.0913, 0.2425}  $\text{yr}^{-1}$ .

The revised algorithm successfully interpreted the breast cancer patients' survival rate at stages 0-IV and evaluated the necessity of radiotherapy for patients at various stages as well. In the stage II, the Average life,  $1/\alpha$  [yr] with/without radiation therapy



was (56.3 vs 37.8 yrs). In the stage III, Average life,  $1/\alpha$  [yr] with/without radiation therapy was (21.0 vs 11.0 yrs), which means that receiving radiation therapy can increase the average life, but there is no significant difference in the stage IV.

**Keywords :** survival rate, breast cancer, algorithm, Taylor series expansion, hit and target model



107CHS-MNR-004

## 使用 Gamma Camera/8-Slice CT 掃描技術，測量放射線 Ga-67 於犬

### 患有肝臟癌症體內之動力學

莊詔勛<sup>1</sup>、陳志峯<sup>1</sup>、曾能泉<sup>2</sup>、詹況栗<sup>2</sup>、潘龍發<sup>3,\*</sup>、潘榕光<sup>1,\*</sup>

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### 摘要

本研究通過體內  $\gamma$ -camera / 8-slice CT 技術闡述犬肝癌病例對照組 Ga-67 進化的生物動力學模型。將一隻肝癌狗和兩隻正常狗運用  $\gamma$ -camera 進一步全身掃描麻醉，測得八個隔室內對時間依賴性的 Ga-67 濃度變化，1: 體液，2: 肝臟，3: GI Tract，4: 腎臟，5: 心臟，6: 剩餘物質，7: 膀胱，和 8: 排泄。每個隔室具有獨特的生物半衰期並與其他隔室連接，指定隔室的初始簡化是基於 ICRP-30 報告推薦的通用生物動力學模型進行。每隻狗在 72 小時內接受 8 次掃描，將依賴於時間的實驗數據一致性的選取至最大的計數/像素/秒，然後與理論估計值積分，以了解隔室之間的相關性。在 MATLAB 中運算自行開發的程序用於反映從  $\gamma$ -camera 掃描獲得的實際性能，AT (Agreement Value) 用於評估經驗和理論結果之間的差異。AT 為 0 意味著理論和實證結果之間的完美一致，而 20 以下的 AT 表示最佳計算和經驗數據之間的良好一致性，而獲得的 AT 的廣泛波動在 7%-60% 的範圍內對應於本研究中的中等數據分歧。在實驗結果中，有限的範圍內（40 對 35 或 15 小時），肝癌狗顯示出比正常狗更長的生物半衰期。最重要的是，結果中其他區室的定量數據和隔室間的分支比率為犬肝臟 Ga-67 的生物動力學模型提供了非常有力的證據。

**關鍵字：**肝癌、生物動力學模型、GA-67、伽瑪相機、MATLAB



## **The First Attempt of The Biokinetic Ga-67 Model Application to Canine Liver Carcinoma: Case-Control Study Via *In-vivo* Gamma Camera/8-Slice CT Technique**

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### **Abstract**

The biokinetic model of Ga-67 evolution was elaborated in this study for the case-control group of canine liver carcinoma via in-vivo gamma camera/8-slice CT technique. One liver carcinoma dog and two normal dogs were anesthetized with the further whole body scanning by a gamma camera to acquire the time-dependent Ga-67 concentration variations among eight compartments, namely: 1. body fluid, 2. liver, 3. GI Tract, 4. kidney, 5. heart, 6. remainder, 7. bladder, and 8. excretion. Each compartment was assumed to have a unique biological half-life and to be connected to other ones. The initial simplification of assigned compartments was performed based on the general-purpose biokinetic model recommended by the ICRP-30 report. Each object/dog underwent eight scans within 72 h. The time-dependent empirical data were normalized to the maximal counts/pixel/sec and then integrated with the theoretical estimates, in order to optimize the correlations among compartments. A self-developed program run in MATLAB was used to reflect the actual performance acquired from the gamma camera scanning, while the dimensionless agreement (AT) was applied to assess the discrepancies between empirical and theoretical results. An AT of zero implies a perfect agreement between the theoretical and empirical results, while AT under 20 indicates an excellent consistency between the optimal computational and empirical data, whereas a wide fluctuation of the obtained ATs in the range of 7%–60% corresponded to a medium range of data disagreement in this study. The liver carcinoma dog has revealed a longer biological half-life than normal dogs in the limited range (40 versus 35 or 15 h). However, the quantified data for other compartments and branching ratios among compartments provided a quite robust substantiation for constructing the biokinetic model of Ga-67 being



administrated in the canine hepatic survey.

**Keywords :** liver carcinoma, biokinetic model, Ga-67, gamma camera, MATLAB



## 運用 Gamma Camera/8-Slice CT 研究放射性碘-131 在甲狀腺亢進貓 之體內動力學模式

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### 摘要

碘在人甲狀腺中的體內動力學模型已研究發展多年，本實驗應用此模型于甲狀腺功能亢進貓的病例對照研究（Case-control study）中，給予 NaI-131 並使用  $\gamma$ camera/8 切 CT 蒐集資料進行研究。甲狀腺功能亢進貓給予 55.5 或 3.7 MBq 的 I-131 放射性溶液，並用  $\gamma$ camera 連續測量。掃描時間點為初始時間、每隔一小時到第六小時、第 24 小時、第 48 小時和第 72 小時，每次收集資料時間為 5 到 10 分鐘。依 ICRP-30 報告中定義碘之體內動力學模型分為五個區塊即胃、體液、甲狀腺、全身和排泄物（Stomach、Body fluid、Thyroid、Whole body 及 Excretion）。資料數據以自行開發的程式輸入商業軟體 MATLAB 中運算，模擬評估貓甲狀腺中碘的體內動力學模型，並模擬每隻貓的不同區塊中時間與 I-131 放射性濃度的變化。胃、體液、甲狀腺、全身和排泄物之生物半衰期分別如下：甲狀腺功能亢進貓分別為 17、3、10、5 和 140 小時，對照組 #1 貓分別為 18、1、8、2 和 40 小時，對照組 #2 貓分別為 22、2、12、4 和 20 小時。伽瑪射線（ $\gamma$ -ray）和  $\beta$  粒子（ $\beta$ -particle）的累積放射性劑量經過簡化算法評估甲狀腺亢進貓為 0.135 Gy、對照組 #1 貓為 0.0082 Gy 和對照組 #2 貓為 0.005 Gy。修正後的體內動力學模型有助于評估貓甲狀腺功能亢進症的代謝機轉，亦可改進寵物甲狀腺功能亢進症時之放射性碘治療。

**關鍵字：**貓、體內動力學、碘-131、甲狀腺、有效劑量



## **Biokinetic Model Development of Radioiodine-131 Via *In-vivo* Gamma Camera/8-Slice CT Technique: Case-Control Study of Feline Hyperthyroidism**

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### **Abstract**

A biokinetic model of iodine in the thyroid was developed and applied to a case control study of hyperthyroid cat undertaken the NaI-131 dose administration using a gamma camera/8-slice CT with the in vivo study. The case-control hyperthyroid cats were administered 55.5 or 3.7MBq of I-131 radioactive solution and continuously surveyed by a gamma camera. The scan schedule was preset as 5- or 10-min counting per each hour from the initial time to the sixth hour, then on the 24th, 48th and 72nd hours, respectively. An in-house developed program run in the MATLAB was applied to evaluate the biokinetic model of iodine in the thyroid, in compliance with the ICRP-30 report regulations. The model was defined by five compartments (namely: stomach, body fluid, thyroid, whole body, and excretion) and allowed one to simulate the variations of time-dependent I-131 radioactive concentration among various compartments of each study subject. The numerical simulation via MATLAB was compiled with the empirical evaluation to optimize the time-dependent concentration of I-131 within the above compartments. The derived biological half-life values for stomach, body fluid, thyroid, whole body, and excretion, respectively, were as follows: 17, 3, 10, 5 and 140 h for hyperthyroid cat, 18, 1, 8, 2, and 40 h for control #1 cat, and 22, 2, 12, 4, and 20 h for control #2 cat. The cumulative radioactive doses from both gamma-ray and beta particles were assessed via a simplified algorithm as 0.135, 0.0082, and 0.005 Gy, for hyperthyroid cat, control #1, and control #2 ones, respectively. The derived biokinetic model was found to be helpful in the evaluation of the metabolic mechanism in case of feline hyperthyroidism. The revealed deviations from available human biomodels can be used for refining the radioiodine treatment of pets with hyperthyroidism.

**Keywords :** feline, biokinetic model, I-131, thyroid, effective dose.



## 牙科 CAD/CAM 用 Co-Cr 合金結構及性質之研究

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### 摘要

牙科鑲復技術已經走入數位時代，近年來許多研究者積極開發新型 Co-Cr 合金以適用於牙科數位製程。本研究探討新開發 CAD/CAM 用 Co-Cr 合金(NX) 的結構和性質，同時選用三款市售 CAD/CAM 用 Co-Cr 合金 WP、AM 和 XS 作為對照組。四款 Co-Cr 合金皆利用數位切削製程 (Computer numerical control, CNC) 來製作樣品。根據 XRD 分析結果顯示三款 WP、AM 和 XS 的 Co-Cr 合金之結構主要為  $\gamma$  (fcc) 相，NX 的 Co-Cr 合金主要是  $\epsilon$  (hcp) 相，三點彎曲強度測試結果顯示，NX 的 Co-Cr 合金具有較佳之抗彎曲強度 1537 MPa；硬度測試結果顯示 NX 的 Co-Cr 合金具有高的硬度值 380 HV；金屬燒付陶瓷後 NX 的 Co-Cr 合金具有較佳之陶瓷結合強度 41.5 MPa。綜合以上結果顯示新開發 CAD/CAM 用的 NX 款 Co-Cr 合金適合應用於牙科數位製程。

**關鍵字：**鈷鉻合金、數位製程、抗彎曲強度、結合強度



## Structure and Properties of Dental Co-Cr Alloys for CAD/CAM Applications

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### Abstract

Dental technology has entered the digital age. In recent years, many researchers have developed new Co-Cr alloys for dental digital processing. This study explored the structure and properties of the developed Co-Cr alloy (NX) for CAD/CAM applications. Three commercial Co/Cr alloys including WP, AM, and XS were selected as the control group. The four Co-Cr alloys were all fabricated using a computer numerical control (CNC). According to the XRD analysis, the structure of three commercial Co-Cr alloys of WP, AM, and XS is mainly  $\gamma$  (fcc) phase, and the NX is mainly  $\epsilon$  (hcp) phase. The three-point bending strength test results show that NX has a good bending strength of 1537 MPa. The hardness of the NX has a high value of 380 HV. The bond strength of the NX Co-Cr alloy and porcelain has a higher value of 41.5 MPa than that of WP, AM, and XS. The above results show that the developed NX Co-Cr alloy is suitable for the dental digital process..

**Keywords :** Co-Cr alloy, digital process, bending strength, bond strength



## 牙科植體用低彈性模數 TNM 合金耐蝕性之研究

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### 摘要

牙科植體用鈦的表面在口腔環境中極易受到侵蝕性氟離子的影響。奈米技術已被證明是一種藉由鈍化膜提高鈦的穩定性和耐蝕性的有效方法。本研究探討氟化物對 Ti-5Nb-5Mo (TNM) 和奈米管 Ti-5Nb-5Mo (TNM-nt) 在人工唾液中 37°C 下腐蝕行為的影響。以電化學方法包括動態電位極化和電化學阻抗譜 (EIS) 以及掃描電子顯微鏡 (SEM) 評估 c.p. Ti、TNM 和 TNM-nt 在含氟人工唾液的耐蝕性。結果顯示 c.p. Ti、TNM 和 TNM-nt 合金在人工唾液中皆具有良好的耐蝕性，在含氟人工唾液中腐蝕電流密度隨著氟濃度的增加而增加。TNM-nt 在含氟人工唾液中具有比 c.p. Ti 和 TNM 更好的耐蝕性。

**關鍵字：**鈦合金、奈米管、人工唾液、耐蝕性



## **Study on Corrosion Resistance of Low Elastic Modulus TNM Alloy for Dental Implants**

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### **Abstract**

The surface of titanium for dental implants is highly susceptible to aggressive fluoride ions in the oral environment. Nanotechnology has proven to be an effective method for improving the stability and corrosion resistance of titanium by passivation films. In this study, we investigated the effect of fluoride on the corrosion behavior of pure titanium (c.p. Ti), Ti-5Nb-5Mo (TNM) and nanotube Ti-5Nb-5Mo (TNM-nt) in artificial saliva at 37 °C. Electrochemical methods including potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) and scanning electron microscopy (SEM) were used to evaluate the corrosion resistance of c.p. Ti, TNM and TNM-nt in fluoride-containing artificial saliva. The results show that c.p. Ti, TNM and TNM-nt alloys have good corrosion resistance in artificial saliva, and the corrosion current density increases with the increase of fluoride concentration in fluoride-containing artificial saliva. TNM-nt has better corrosion resistance than c.p. Ti and TNM in fluoride-containing artificial saliva.

**Keywords :** titanium alloy, nanotube, artificial saliva, corrosion resistance



## 比較數位光源處理技術與傳統熱聚合製程之義齒基底特性

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### 摘要

臨床上用於製作全口義齒基底材料之聚甲基丙烯酸甲酯 (polymethyl methacrylate, PMMA)，不論使用何種製程方式皆會有聚合收縮及單體揮發之問題發生。近來，數位光源處理 (digital light processing, DLP) 技術正於牙科補綴技術快速發展，此技術是利用三維列印 (three dimensional Print, 3D Print) 方式製造義齒基底材料，是一種新穎義齒製造方式，可提升義齒製造之工作效率。然而，數位光源處理技術應用於製作義齒基底材料的研究甚少。本研究將比較數位光源處理技術與傳統熱聚合製程之義齒基底特性。利用 DLP 技術列印三種不同成型方向 ( $D_X$ 、 $D_Y$ 、 $D_Z$ ) 與傳統熱聚合樹脂 ( $T_H$ ) 進行機械特性測試。實驗結果顯示  $D_Z$  成型方向顯示具有最佳的表面硬度、彎曲強度及表面親水性，與傳統熱聚合義齒基底材料之機械特性最接近。

**關鍵字：**聚甲基丙烯酸甲酯、義齒基底、積層製造、數位光源處理技術



## **Comparison of Denture Base Properties between Digital Light Processing Technique and Conventional Thermal Polymerization Method**

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### **Abstract**

Polymethyl methacrylate (PMMA) applied to denture base material in clinical still has problems with polymerization shrinkage and monomer volatilized. Recently, digital light processing (DLP) technology is rapidly developing in dental technology, this technology is use three-dimensional print (3D Print) to make denture base materials. A novel denture manufacture method, can improve the work efficiency of denture manufacture. However, the influence mechanism of DLP technology for mechanical properties on the denture base material is still very limited. The study is to comparison of denture base properties between digital light processing technique and conventional thermal polymerization method. Three different build orientation (X : horizontal ; Y : vertical ; Z : edge) were printed. The corresponding resin specimens were designated as  $D_X$ ,  $D_Y$  and  $D_Z$ , respectively. The traditional thermal polymerization resin (control group) was designated as  $T_H$ . The results show that the  $D_Z$  build orientation show the best surface hardness, bending strength and surface hydrophilicity, which is the close to the mechanical properties of the traditional thermal denture base material..

**Keywords :** polymethyl methacrylate, denture base, additive manufacturing, digital light processing



## 添加氧化鋇對 $\text{MgO-CaO-Al}_2\text{O}_3\text{-SiO}_2\text{-P}_2\text{O}_5$ 生物活性玻璃之影響

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### 摘要

鋇元素有助於成骨細胞之生長，添加至生物活性玻璃中，可透過降解，將鋇離子釋放到周圍骨組織，增進材料的骨組織增生。本研究將氧化鋇添加至團隊自行研發之生物活性玻璃中，探討鋇對玻璃化轉化溫度，鈣磷層沉積，降解和離子釋放的影響。玻璃的成分為  $\text{MgO}$  3%， $\text{CaO}$  (35-x) %， $\text{Al}_2\text{O}_3$  8.6%， $\text{SiO}_2$  41.4%， $\text{P}_2\text{O}_5$  12%， $\text{SrO}$  x% (x = 0, 1, 3, 5, 10 wt%)，分別以 xSrAA 表示。實驗結果顯示，SrAA 玻璃轉化溫度為 741-770°C，添加鋇會增加玻璃轉化溫度與結晶溫度之差距(燒結窗口)，使燒結時間增加而不產生結晶相。在降解作用方面，將 SrAA 試片浸泡在 PBS 中，隨著浸泡時間增加，pH 值逐漸增加。鋇含量愈多，pH 值增加較不明顯，且磷灰石沉積較少，顯示氧化鋇的添加，有助於 AA 玻璃的穩定。生物相容性試驗顯示，SrAA 玻璃試片與 MG-63 共培養後，5SrAA 有最佳的細胞活性。

**關鍵字：**生物活性玻璃、鋇、鈣磷層、降解



## Effect of Adding Strontia on MgO-CaO-Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub>-P<sub>2</sub>O<sub>5</sub> Bioactive Glass

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### Abstract

Strontium is believed to contribute to the growth of bone cells. By the way of degradation, strontium-containing bioactive glass would release strontium ions into the surrounding environment, to promote the bioactivity. In this study, strontium-containing bioactive glass with composition of MgO 3%, CaO (35-x)%, Al<sub>2</sub>O<sub>3</sub> 8.6%, SiO<sub>2</sub> 41.4%, P<sub>2</sub>O<sub>5</sub> 12%, SrO x% (x = 0, 1, 3, 5, 10 wt.%) (denoted by xSrAA, respectively) were synthesized using conventional melt quenching technique. The effects of strontia on glass transition temperatures, apatite-forming ability, degradation in physicochemical solution, and ion release were investigated. The experimental results showed that the glass transition temperatures were in the range of 741-770°C. The strontia would widen the sintering window, which means the glass could maintain the glass phase condition with longer sintering duration. In terms of degradation, the test specimens were immersed in PBS solutions. The pH value increased gradually with immersion duration. However, the more strontia content, the steadier pH values were in immersing PBS solutions. In addition, strontia also reduced the apatite deposition in PBS solutions. All these results revealed that SrAA glasses were more stable than AA glasses in PBS solutions. After co-cultured with MG-63 cells, 5SrAA showed the best cell activity.

**Keywords :** bioactive glass, strontium, apatite, degradation



## 以脈衝氧化法表面處理牙科植體用鈦合金之研究

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### 摘要

鈦及鈦合金因其質量輕、低密度、高強度、耐腐蝕性佳和良好的生物相容性而被廣泛使用於牙科和整形外科植體。然而，鈦金屬 (110 GPa) 與人骨 (0.1-30 GPa) 的彈性係數相比高出許多，這可能導致骨質疏鬆，造成植體鬆動及脫落的原因，鈦植體抗菌表面改質似乎是有效的解決方法。新型 Ti-Nb-Mo (TNM) 合金擁有相當低的彈性模數及高強度/彈性模數的比值，適用於牙科植體。植體表面製備奈米管不僅可以增加細胞的貼附，也能作為金屬顆粒的負載體。銀是廣效的抗菌劑，且不對哺乳類細胞產生毒性。脈衝氧化可以藉由調節電壓、頻率和工作週期改變表面形貌。因此，在本研究中透過脈衝氧化在 TNM 合金的表面上製造摻銀奈米管，製備參數包括電壓和工作週期。實驗結果顯示 TNM 合金表面製備的奈米管受電壓和工作週期的影響。EDS 分析證明銀成功地摻入到 TNM 合金的表面，XRD 分析發現熱處理後合金表面有銳鈦礦相形成，AFM 分析顯示奈米管 TNM 合金 (TNM-nt) 具有較高粗糙度，並且摻入銀的奈米管 TNM 合金 (TNM-nt-Ag) 具有小於 30 度的水接觸角表示具有良好的親水性。

**關鍵字：**鈦合金、奈米管、脈衝氧化法、抗菌性



## Surface Modification of Dental Implant Titanium Alloy by Pulse Oxidation Method

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### Abstract

Titanium and its alloys are widely used in dental and orthopedic implants due to their light weight, low density, high strength, good corrosion resistance and good biocompatibility. However, there is still a large gap between the titanium (110 GPa) and the human bone (0.1-30 GPa), which may lead to osteoporosis, causes of the loosening and shedding of the implant. The new Ti-Nb-Mo (TNM) alloy has a relatively low modulus of elasticity and a high strength/elastic modulus ratio for dental implants. In addition, titanium is a biologically inert material and does not have sufficient antibacterial properties, which is also an important cause of implant failure. Preparation of the nanotube surface on the implant surface not only increases the attachment of the cells, but also acts as a support for the agent or metal particles. Silver is widely used as a broad spectrum antibacterial agent and is not toxic to mammalian cells. Pulse oxidation can affected surface topography by adjusting voltage, frequency and duty cycle. Therefore, in this study, silver-incorporated nanotubes were fabricated on the surface of a TNM alloy by pulse oxidation, and the parameters including voltage and duty cycle. The experimental results show that the nanotubes prepared on the surface of the TNM alloy are affected by voltage and duty cycle. EDS analysis demonstrates that silver successfully incorporates to the surface of the TNM alloy, XRD analysis revealed the formation of an anatase phase after heat treatment, AFM analysis showed that the nanotube TNM alloy (TNM-nt) had a higher roughness, and the silver-incorporated nanotube TNM alloy (TNM-nt-Ag) having a water contact angle  $< 30^\circ$  indicates good hydrophilicity.

**Keywords :** titanium alloy, nanotube, silver, antibacterial



## 以層級分析法探討營造業勞工墜落防護具使用之研究

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### 摘要

營造業職業災害比率一向高居不下，根據 106 年勞動檢查年報顯示，106 年各行業平均失能傷害嚴重率為 114，以木竹製品製造業之失能傷害嚴重率 1,210 為最高，其次為營造業 766；106 年全產業的職業傷害千人率為 2.773，營造業高居 10.036，因墜落而罹災人數更是佔 106 年營造業罹災在人數的 54%。每件職業災害發生，就代表背後一個家庭支柱倒下，而職業災害所造成的直接損失及間接損失嚴重影響公司經營上的獲利及企業形象。而營造業又與一般製造業有顯著的差異，其特性在於產品的多元性、作業複雜性及環境的多變性，因營造業由於工種繁多、作業人員異動頻繁、作業環境不佳、作業場所不固定、受天候地質影響、危害隨工程進行變動加上多分層分包承攬等因素，造成營造業先天具有較高之風險使得營造業之重大職業災害比率高居不下。

如何降低營造業發生職災風險控制措施及步驟，包含事業單位應訂定不可接受風險之判定基礎，作為優先決定採取降低風險控制措施的依據。不可接受風險的判定基準並非持續固定不變，事業單位應依實際風險狀況可用資源等因素，適時調整不可接受風險判定基準值，已達持續改善之承諾，對於不可接受風險項目應依消除、取代、工程控制及管理控制，最後如前述方法依然無法消除風險，則須讓勞工使用個人防護具以有效降低風險。然而根據近年來營造業罹災因素分析結果來看，未使用個人防護具及不安全的行為分別佔據災因前兩名，作為勞工最後一道防護之個人防護具，勞工卻常不去或不正確之使用，為預防職業災害發生，本研究之目的為釐清為何勞工忽略個人防護具的使用，應用問卷統計及層級分析法加以分析，依分析結果找出原因並擬定相對應之措施。

**關鍵字：**營造業、墜落危害、個人防護具、層級分析法、問卷調查



## **The Study of Personal Fall Protective Equipment for Construction Workers by Analytic Hierarchy Process**

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### **Abstract**

The occupational disaster rate in the construction industry has always remained high. According to the labor inspection annual report, the average rate of disability injury in various industries was 114 in 2017, and the highest rate of disability injury in the wood and bamboo products manufacturing industry was 1,210, followed by the construction industry. 766; In 2017, the occupational injury rate of the whole industry was 2.773, and the construction industry was 10.036 the number of people affected by the fall is 54% of the number of people in the construction industry. Every occupational disaster occurs, which represents a family pillar behind it. The direct losses and indirect losses caused by occupational disasters seriously affect the company's profitability and corporate image. The construction industry is also significantly different from the general manufacturing industry. Its characteristics are the diversity of products, the complexity of operations and the variability of the environment. Due to the variety of work, the frequent changes of workers, the poor working environment and the workplace Fixed, weather-affected geological impacts, hazards with changes in the project, and multi-layered subcontracting and other factors have caused the construction industry to have a high risk of innate nature, making the construction industry's major occupational hazard ratio high.

How to reduce the risk control measures and steps for occupational disasters in the construction industry, including the basis for determining the unacceptable risks of the public institutions, as the basis for taking priority measures to reduce risk control measures. The basis for the determination of unacceptable risks is not consistently fixed. The public institution should adjust the unacceptable risk determination benchmark value according to the actual resources and available resources and other factors, and has reached the promise of continuous improvement. For unacceptable risk projects, it should be eliminated and replaced. , engineering control and management control, and finally, if the above methods still cannot eliminate the risk, the workers must use personal protective equipment to effectively reduce the risk. However, according to the analysis results of the disaster relief factors in the construction industry in recent years, the use of personal protective equipment and



unsafe behavior respectively accounted for the top two causes of the disaster. As the last protective personal protective equipment for the workers, the workers often did not go or were incorrect. In order to prevent occupational disasters, the purpose of this study is to clarify why workers neglect the use of personal protective equipment, use questionnaire statistics and hierarchical analysis to analyze the causes, and find out the corresponding measures according to the analysis results.

**Keywords :** construction industry, fall hazard, personal protective equipment, hierarchical analysis, questionnaire survey

## 寺廟大氣中焚香之醛酮類化合物與重金屬成分特徵分析

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### 摘要

寺廟焚香在燃燒過程中，含有氣相之醛酮化合物與金屬顆粒在寺廟空間中，對民眾或廟方工作人員造成健康上的影響。2018 年採集南投縣兩間 A 與 B 寺廟各 7 天及 9 個天之焚香空氣樣本，醛酮化合物與氣膠樣本分別是利用矽膠吸附管與 Moudi 四階衝擊板空氣採樣器採集 8 小時，而醛酮化合物與金屬元素則分別利用高效能液相層析儀紫外線偵測器(HPLC/UV)及感應耦合電漿源子發射光譜儀(ICP/OES)進行分析。

在焚香過程中，A 寺廟最高的質量濃度為粒徑 $<1.0\mu\text{m}$ 之  $12.64\pm 3.99\ \mu\text{g}/\text{m}^3$ ，而粒徑  $\text{PM}_{10-2.5}$  對於總懸浮粒徑質量比值為  $16.65\%\pm 5.89\%$ ， $\text{PM}_{2.5-1}$  和  $\text{PM}_1$  分別占總懸浮粒徑質量之  $18.11\%$ 和  $46.08\%$ 。而 B 寺廟最高的質量濃度為粒徑  $2.5-1.0\mu\text{m}$  之  $7.62\pm 3.02\ \mu\text{g}/\text{m}^3$ ，而粒徑  $\text{PM}_{10-2.5}$  與  $\text{PM}_1$  對於總懸浮粒徑質量比值分別占  $17.39\%$ 和  $52.19\%$ 。B 寺廟有推廣減香活動，其 A 寺廟總懸浮微粒是 B 寺廟之 1.42 倍，且不論寺廟是否減香，其焚香燃燒之粒狀物皆以奈米粒狀物( $\text{PM}$  粒徑 $<1\mu\text{m}$ )佔總懸浮微粒約 50%，顯示對人體危害值得注意。

在有害重金屬元素濃度方面，A 寺廟之濃度最高為鋅( $5.05\ \mu\text{g}/\text{m}^3$ )、鉛( $0.32\ \mu\text{g}/\text{m}^3$ )和錳( $0.27\ \mu\text{g}/\text{m}^3$ )，而 B 寺廟最高為鋅( $3.78\ \mu\text{g}/\text{m}^3$ )，其次是錳、銅和鉛，濃度約  $0.22-0.29\ \mu\text{g}/\text{m}^3$ 。醛酮類化合物之危害暴露方面，A 寺廟之濃度最高為乙醛( $13.05\pm 6.19\ \mu\text{g}/\text{m}^3$ )、甲醛( $12.94\pm 3.55\ \mu\text{g}/\text{m}^3$ )和丙烯醛( $8.81\pm 5.06\ \mu\text{g}/\text{m}^3$ )，而 B 寺廟為甲醛( $11.66\pm 4.79\ \mu\text{g}/\text{m}^3$ )、乙醛( $6.20\pm 3.01\ \mu\text{g}/\text{m}^3$ )和對甲基苯甲醛( $2.75\pm 1.08\ \mu\text{g}/\text{m}^3$ )。

在健康暴露風險評估方面，A 寺廟與 B 寺廟之焚香中鎘、鈷、鉻、鎳、鉛、鋅與砷之致癌金屬在總懸浮微粒中的總致癌風險值為  $8.8\times 10^{-5}$  及  $7.0\times 10^{-5}$ 。甲醛、乙醛及丙烯醛之暴露危害並未超過可接受之致癌風險值( $10^{-6}$ )。值得注意的是，寺廟工作人員的健康風險評估值顯示鉻、鎳、鋅與砷之重金屬均超過致癌風險值( $10^{-6}$ )，表示寺廟焚香環境中是有潛在的致癌風險存在。因此，推動減香活動可



以達到健康環境與經濟效應之雙贏目的。

**關鍵字：**寺廟、焚香、粒徑分佈、重金屬、醛酮類化合物、健康風險評估



## Characteristics of Carbonyl Compounds and Heavy Metals in the Air of Incense Burning from the Temples

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### Abstract

The health effects of aldehydes, ketones and metal-containing incense-particles on staffs at temples during incense burning periods. Samples were collected over 7 and 9 working days at A and B temple in Nantou County, 2018. Carbonyl compounds and aerosol samples were collected for 8 h using the solid sorbent tube and 4 impaction stages of Moudi Impactor, respectively. Carbonyl compounds and metal-containing particles were analyzed using a high performance liquid chromatography with UV detector (HPLC/UV) and an inductively coupled plasma with optical emission spectroscopy (ICP-OES).

Measurement results show that the particles with the highest mass concentrations were  $PM_{<1.0}$  ( $12.64 \pm 3.99 \mu\text{g}/\text{m}^3$ ) at A temple. The mass ratios of  $PM_{10-2.5}$  to total PM was  $16.65\% \pm 5.89\%$ . The  $PM_{2.5-1}$  and  $PM_1$  constituted 18.11% and 46.08% of the total PM mass, respectively. Particles with the highest mass by size were  $PM_{2.5-1}$  ( $7.62 \pm 3.02 \mu\text{g}/\text{m}^3$ ) at B temple. The mass ratios of  $PM_{10-2.5}$  relative to total PM and those of  $PM_1$  to total PM were 7.39% and 52.19%, respectively. The mass of total particles at A temple was approximately 1.4 times higher than that at B temple because of incense reduction at B temple. Overall, the mass ratios of  $PM_1$  relative to the total particles 46.08 to 52.19%.

The most abundant metal elements in all particle sizes on all sampling days were Zn ( $5.05 \mu\text{g}/\text{m}^3$ ), Pb ( $0.32 \mu\text{g}/\text{m}^3$ ) and Mn ( $0.27 \mu\text{g}/\text{m}^3$ ) at A temple. The most abundant metal elements of all fractions were Zn ( $3.78 \mu\text{g}/\text{m}^3$ ); these were follow by Mn, Cu and Pb with concentrations of 0.22 to  $0.29 \mu\text{g}/\text{m}^3$  at B temple. The formaldehyde, acetaldehyde, Acrolein and p-methyl benzaldehyde were identified during incense burning periods, the concentrations ranges from 2.75 to  $13.05 \mu\text{g}/\text{m}^3$ .

Cancer risks of carcinogenic metals (Cd, Co, Cr, Ni, Pb, Zn and As) in total particles were  $8.8 \times 10^{-7}$  and  $7.0 \times 10^{-5}$  for staffs at A and B temple, respectively. The cancer risk of formaldehyde, acetaldehyde and Acrolein did not exceed the  $10^{-6}$  acceptable level. Significantly, health risk assessment revealed that the risk values (Cr, Ni, Zn and As) for staffs were all above the guidelines of cancer risk ( $10^{-6}$ ) at two temples, indicating that there are potential cancer risk at the temples workplace during



incense burning periods. Therefore, the policy of incense reduction might achieve healthy environments and economic win-win goal.

**Keywords :** Temple 、 Incense burning 、 Size distributions; Heavy metals; Aldehydes and Ketones; Health-risk assessment



## 驗光室燈光設置對視機能檢查影響之研究

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### 摘要

常規驗光室之環境亮度僅適用於標準視覺功能測量，無法推估在不同環境照度下之功能性視覺。本研究以建立不同環境照度下視力表現之標準，作為驗光人員評估視覺機能之依據。

本研究依照中華民國國家標準(Chinese National Standards, CNS)之室內環境照度規範，分別模擬 300、200、150、100 及 30 ~ 50 lux 五種環境照度，隨機挑選 30 位年滿 20 歲受試者，排除患有眼疾、使用散瞳劑以及斜弱視者。測量其客觀屈光度、慣用處方度數、角膜曲率、眼軸長度及角膜厚度。分別使用投影及紙本視力表，在五種照度下測量遠距離(6 m)視力及瞳孔直徑，再以 SPSS 統計軟體分析其結果。

以辦公室環境照度(300 lux)為基準比較走道及梯間照度(30 ~ 50 lux)標準，在投影視力表( $p < 0.01$ )及紙本視力表( $p < 0.01$ )均有顯著差異，其他環境照度亦有不等的視力表現差異。投影視力表在較低的環境照度有較佳的視力表現，而紙本視力表則以較高的環境照度下視力表現較佳，推論與視標之對比度有關。

本研究建立不同環境照度下視力表現之標準，提供驗光人員評估患者在日常生活是否具有功能性視覺障礙之依據。

**關鍵字：**照度、驗光室、視力、視機能



## **The Effect of Refractive Room Illumination on Visual Functional Tests**

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### **Abstract**

The environmental illumination of a common optometric room is only suitable for standard visual function measurements and cannot be used to estimate functional vision under different environmental illumination levels. This study establishes the standard of visual performance under different environmental illumination as the basis for optometric personnel to evaluate visual function.

This study simulates five environmental illumination of 300, 200, 150, 100 and 30 ~ 50 lux according to the indoor environmental illumination specifications of the Chinese National Standards. The study included 30 subjects over the age of 20, and exclude who has eye diseases, using atropine, strabismus and amblyopia. We measured the objective diopter, corneal curvature, axial length and corneal thickness. The long-distance (6 m) visual acuity and pupil size were measured under five illuminations using a projector chart and visual acuity card, and the results were analyzed by SPSS statistical software.

Compare of aisle and ladder illumination 30~50 lux based on office ambient illumination 300 lux, there has significant differences in projector chart ( $p < 0.01$ ) and visual acuity card ( $p < 0.01$ ), other environments illumination also has varying visual performance differences. The projector chart has better visual performance in lower environmental illumination, while the visual acuity card is better in visual acuity with higher environmental illumination, and the inference is related to the contrast of the visual standard.

This study establishes the standard of visual performance under different environmental illumination, and provides the basis for optometric personnel to assess whether patients have functional visual impairment in daily life..

**Keywords :** illumination, optometric room, visual acuity, visual function



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## 簡易快速之生物細胞富集晶片開發

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### 摘要

近年來高齡產婦的比率逐漸增加，產前的診斷就更加重要。除了傳統的羊水檢查方法之外，因為孕婦的血液中含有極少量的胎兒紅血球(nucleated red blood cells；NRBCs)，我們也可藉由揀選出孕婦血液中的極少量的胎兒紅血球，檢驗胎兒的健康狀況。此方法主要屬於非侵入式的(non-invasive)檢測，所以，在臨床的應用方面也極具潛力。

本研究成功地以新式數位光投影(digital light processing, DLP ) 3D 列印技術製造簡易且快速之生物細胞富集晶片。以抗體(CD147)塗層於微流道中之細胞捕捉陣列柱，藉以捕獲孕婦血液中含量集少的有核紅血球。此項研究之成功亦可擴展應用到其他稀少性細胞的富集，例如循環腫瘤細胞的篩檢，對醫學臨床應用將有重要貢獻。

**關鍵字：**光固化 3D 製造、數位光投影、微流道生醫晶片、有核紅血球、細胞富集



## **Development of Simple and Rapid Enrichment Biochip**

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### **Abstract**

Recently the pregnant women ages are gradually increasing, and prenatal diagnosis is becoming crucial. Excepting the conventional invasive inspection method of amniocentesis, the very small amounts of nucleated red blood cells (NRBCs) in pregnant women's blood can be selected for non-invasive diagnosis.

This study applies the new digital light projection 3D printing technology to fabricate simple and rapid enriched biochips. The antibody (CD147) was coated onto the array column captures in the microchannel to capture the NRBCs from the pregnant woman blood. The concept of this study can be applied to the other rare cells enrichment, such as screening circulating tumor cells, which is expected to offer important contributions to clinical medical applications.

**Keywords :** Photopolymerization 3D fabrication, Digital Light Processing, microfluidic bio-chip, Nucleated red blood cells, Cell enrichment



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## 多重尺寸光固化 3D 列印製造之開發

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### 摘要

近年來，微流道晶片的發展，對生醫檢測提供了多樣化的可能性。在微流道生醫晶片(Microfluidic bio-chip)的研究與應用中，除微流道本身之外，流道中的功能性微型裝置是關鍵，然而這兩者之精細度要求有所不同，雙光子光致聚合(Two-photon photopolymerization 2PP)製造技術可製作相當細緻的微機械裝置，但不利於較大尺寸微流道和多重微裝置的製作；反之，單光子光致聚合(1PP)製造技術相當適合用來製作 2.5D 的微流道，但無法達到微米級 3D 機械裝置的需求。

於是，本研究運用單光子聚合(Single-photon polymerization, 1PP)機制之數位光投影(Digital Light Processing, DLP)以光固化(Photopolymerization)原理，並擷取 2PP 之高空間解析度光固化概念，將數位投影圖像耦合到光學顯微鏡，經過高數值孔徑之物鏡形成類似 TPP 的微小成化區，將可大幅提高微流道生醫晶片的研發效率，並可提高光固化 3D 製造技術之應用範圍。

**關鍵字：**光固化 3D 製造、數位光投影、單光子光致聚合、雙光子光致聚合、微流道生醫晶片



## **Decelopment of Multi-scale Photo-polymerization 3D Printing Fabricaiton**

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### **Abstract**

Recently the development of the microfluidic biochip has offered diverse possibilities of biomedical inspection. In the research and application of microfluidic biochip, both of those devices are important for the achievement of the microfluidic chip, the functional microdevices are much more crucial than the microchannels. In addition, they have different requests on precision. The two-photon polymerization (2PP) can be employed for fabricating high precise micromachines, but not for large scale microchannels. Contrarily, one-photon polymerization (1PP) is good at fabricating the 2.5D microchannels, but not 3D micro-scale micromachines.

This study employs the digital light projection (DLP) of 1PP to achieve rapid light curing, and takes the advantage of 2PP to obtain high spatial resolution. The method is to project digital images onto an optical microscope with an objective of high numerical aperture (N.A.). The formation of the curing zone is similar with 2PP. The achievement of this study is expected to apply to the fabrication of microchannels, and to expand the application light curing 3D manufacturing technology.

**Keywords :** Photopolymerization 3D fabrication, Digital light processing,  
Single-photon photopolymerization, Two-photon photopolymerization,  
Microfluidic biochip.



## 黑腐病菌 *clpX* 基因之特性

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### 摘要

革蘭氏陰性菌 *Xanthomonas campestris* pv. *campestris* (XCC) 為造成十字花科植物感染黑腐病的病原菌，其毒力因子包括胞外酵素、胞外多醣與生物膜形成。先前藉由轉位子隨機誘變，分離到一株吸附能力下降之突變株，該突變株被轉位子插壞的基因之編碼產物被推估為 ClpX，為 ClpXP 蛋白酶之 ATPase 次單位。ClpXP 廣泛存在於細菌中，功能在於因應環境壓力改變，參與蛋白質品質管控，亦與許多致病菌之毒力有關；然而，在 XCC 之生理角色則未知。本研究發現 *clpX* 基因突變導致胞外酵素（包括蛋白酶、纖維酶、聚甘露糖酶及果膠酸裂解酶）與吸附於非生物性與生物性表面之能力下降。利用反轉錄定量即時聚合酶鏈鎖反應分析，得知編碼主要細胞外酵素與生物膜相關蛋白的基因之表現量，在 *clpX* 突變株均低於野生株。此外，*clpX* 突變株對於宿主植物之致病性與溫度、抗生素 puromycin 與界面活性劑 sodium dodecyl sulfate 之耐受性亦低於野生株。這些由於 *clpX* 突變而改變之表型，均可透過回補完整的 *clpX* 基因而恢復。本研究為 *Xanthomonas clpX* 基因功能探討之首篇報導。

**關鍵字：**黑腐病菌、*clpX* 基因、毒力



## Characterization of *clpX* Gene in *Xanthomonas campestris* pv. *campestris*

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### Abstract

The gram-negative *Xanthomonas campestris* pv. *campestris* (XCC) is the pathogenic bacterium that causes black rot disease in crucifers. The virulence determinants of this bacterium include extracellular enzymes, exopolysaccharides, and biofilm formation. Previously, a transposon mutant of XCC showing reduced production of bacterial attachment was isolated and subsequent analysis revealed this mutant carries the transposon insertion in *clpX*, a gene encoding ATPase subunit of the ClpXP protease. The ClpXP protease is widely conserved in bacteria, has roles in protein quality control in response to a wide variety of environments, and also involved in the virulence of many pathogenic bacteria. However, the role of ClpXP in XCC remains unknown. In this study, it was found that mutation of *clpX* revealed decreased levels of extracellular enzymes and impacted ability to attach to abiotic and biotic surfaces. Reverse transcription quantitative real-time polymerase chain reaction assays indicated that mutation in *clpX* diminished the expression of genes that encode the major extracellular enzymes and the biofilm-related proteins. The *clpX* mutant also exhibited reductions in virulence on the host cabbage and tolerance in the presence of a range of stresses, including temperature, puromycin and sodium dodecyl sulfate. These affected phenotypes of the *clpX* mutant could be complemented to wild-type levels by the intact *clpX* gene. This is the first report to characterize the function of *clpX* in *Xanthomonas*.

**Keywords :** *Xanthomonas campestris* pv. *campestris*, *clpX* gene, virulence



## 雙眼視異常症狀調查問卷之建立

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### 摘要

雙眼視覺異常之症狀嚴重程度是視光臨床診斷與處置的重要依據，但症狀的臨床評估方式並不一致。本研究針對非斜視性雙眼視覺異常症狀進行問卷信效度評估。問卷共 26 題，以該症狀出現頻率估計嚴重度。在效度部分，本問卷進行專家效度評估；在信度部分，針對 18-35 歲健康成人進行施測者間信度與再測信度評估。施測者間信度分別由兩位檢查者進行；再測信度之重複問卷評估與第一次問卷評估之間隔時間不超過兩週。42 位受試者平均年齡  $23.1 \pm 4.7$  歲，其中男生佔 21.43%、女生 78.57%。施測者間信度之 Spearman's rho 相關係數，視近症狀有 13 題  $r = 1$ ；視遠症狀中，無法持久集中注意力  $r = 0.81$  ( $p < 0.001$ )，其餘 12 題則  $r = 1$ 。再測信度之 Spearman's rho 相關係數，視近症狀中，眼睛疲勞  $r = 0.96$  ( $p < 0.001$ )、跳行反覆閱讀  $r = 0.81$  ( $p < 0.001$ )、閱讀時想睡覺  $r = 0.95$  ( $p < 0.001$ )、看近換看遠聚焦困難  $r = 0.86$  ( $p < 0.001$ )，其餘 9 題  $r = 1$ ；視遠症狀中，眼睛疲勞  $r = 0.95$  ( $p < 0.001$ )、無法持久集中注意力  $r = 0.81$  ( $p < 0.001$ )、光亮時閉上其中一眼  $r = 0.88$  ( $p < 0.001$ )，其餘 10 題  $r = 1$ 。問卷調查結果顯示良好信效度，可作為非斜視性雙眼視異常症狀調查診斷之依據。

**關鍵字：**非斜視性、雙眼視異常、信效度、問卷



## Development of the Questionnaire for Investigating the Symptoms of Binocular Vision Anomalies

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### Abstract

The severity of binocular vision anomalies is important for clinical diagnosis and treatment, but the clinical symptoms are not consistent. In this study, a questionnaire was designed for non-strabismus binocular vision anomalies, the reliability and validity of the questionnaire were evaluated. A total of 26 questions were used to assess the severity of the symptom frequency. As the effect, the questionnaire is used for expert effectiveness evaluation. For reliability, healthy adults aged 18-35 were used to assess the reliability of the test room and the reliability of the retest. The inter-tester reliability is performed by two examiners; the interval between the repeated questionnaire test of the retest reliability and the first questionnaire test is less than two weeks. A total of 42 human sample was invited to participate in the survey. The average age of the subjects was  $23.1 \pm 4.7$  year old, among these, 21.43% was men and 78.57% as women. Spearman's rho correlation coefficient between the inter-testers, 13 questions  $r = 1$  depending on the symptoms; In the far-sighted symptoms, it was inability to sustain and concentrate  $r = 0.81$  ( $p < 0.001$ ), and the remaining 12 questions were  $r = 1$ . Spearman's rho correlation coefficient of retest reliability, asthenopia  $r = 0.96$  ( $p < 0.001$ ), repeated reading  $r = 0.81$  ( $p < 0.001$ ), and sleepiness when reading  $r = 0.95$  ( $p < 0.001$ ), near vision to see the far focus difficulty  $r = 0.86$  ( $p < 0.001$ ), the remaining 9 questions  $r = 1$ . In the far-sighted symptoms, asthenopia  $r = 0.95$  ( $p < 0.001$ ), inability to maintain concentration  $r = 0.81$  ( $p < 0.001$ ), and one of the eyes closed at  $r = 0.88$  ( $p < 0.001$ ) when the light was bright, the remaining 10 questions  $r = 1$ . The results of the questionnaire reveal good reliability and validity, and can be used as a basis for investigation and diagnosis of abnormal symptoms of non-strabismic eyes..

**Keywords :** non-strabismus, binocular anomalies, reliability and validity, questionnaire



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