# The effects of bismuth subgallate content on the radiopacity and cytocompatibility of calcium phosphate cement

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## Introduction

Calcium phosphate cements (CPC) can self-harden to form hydroxylapatite and possess good bone ingrowth ability. Combining with their plasticity, good clinical interoperability, CPC can be applied to complex shape in the repair of fractures, bone defects, hemostatic surgical bleeding of bone. However, the traditional CPC hardening time is too long, when contact with blood or body fluids en-setting CPC will collapse if no other bonding additives. The purpose of this study was to investigate the effects of adding bismuth subgallate (BS) (a coagulant/ radiopacity agent) to the calcium phosphate cement (CPC) on its blood clotting time, radiopacity and cell viability.

## Materials & Methods

5, 10, 15wt% BS (5BS, 10BS, 15BS) were added to the CPC original powder (TTCP/DCPA) and mixed with 1M phosphoric acid at a liquid/ powder ratio of 0.35. The pastes were filled in a stainless mold to form specimens of 3mm thickness and 6mm diameter. Samples without BS were set as control group. The clotting time was determined by dropping 5μL adult whole blood on each specimen and measured the total time until protein fiber formation which was tested every 15sec by a blood taking needle. For X-ray opacity measurements 1mm thick samples were produced. The X-ray generator (UD150L-30E, Shimadzu, Japan) was established at the China Medical University (CMU) and used to irradiate the CPC or CPC with BS samples. The exposure was taken at 42 kVp and 200 mAs. MG63 human osteosarcoma cell viability were measured by MTT assay at 1 hour and 24 hours. Data were analysis by ANOVA followed with Tukey's test for post-hoc mean comparison.

## Results & Discussion

As shown in the Figure 1, The clotting time of 10BS (358±6sec) is significantly shorter than that of the control group (418±13sec, $p<0.001$). The clotting time of15BS is only 188±7sec. The radiopacity of CPC has been significantly improved by adding 5% BS (Figure 2). All the test samples are siginificant different ($F(3, 12)=78.98$, $p<10^{-5}$). After running the Mephysto software, $R^2$ values between BS concentration (%) and optical density (OD) were close to 1. The one hour cell viability of each group containing BS was higher than that of the control group and blank group. After 24 hours, cell viabilities of BS-contained groups were still higher than that of the control group but there were no significant difference to the blank group (Figure 3).

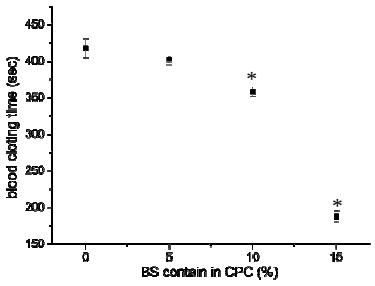


**Fig. 1.** Clotting time of CPC 0%, 5%, 10%, and 15% BS. * means significant different to the control group.

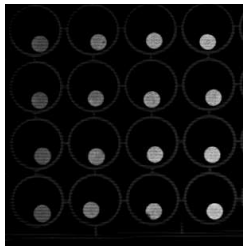

**Fig. 2.** Radiographic images of CPC 0% (first raw), 5% (2nd raw), 10% (3rd raw), and 15% (4th raw) BS.

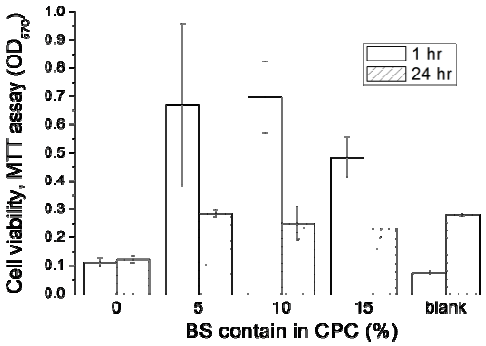


**Fig. 3.** One hour and 24 hours cell viabilities of MG63 cells on CPC with 0%, 5%, 10%, and 15% BS compare to the blank (culture well).

## Conclusion

Adding more than 10wt% BS can significantly accelerate the blood clotting of the present CPC. And the radiopacity of CPC has been significantly improved by adding 5% BS. Adding BS will increase the viability of MG63 cell at the first hour, but the cell viabilities at 24 hours were similar to the blank group..

## References

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