

Evaluation Of Flexural Strength And *Candida Albicans* Adherence To Silver Nanoparticles Reinforced 3D Printed And Heat-Cured PMMA Polymers: An *In-Vitro* Study

Pradeep Kumar, BDS, MDS; Himanshi Aggarwal*, BDS, MDS, MS; Daniel A Givan, DMD, PhD; Nathaniel C Lawson, DMD, PhD; Ping Zhang, DDS, PhD; Chin-Chuan Fu, DDS, MS

*University of Pittsburgh School of Dental Medicine. MS Research done while affiliated to UAB



INTRODUCTION

PMMA is susceptible to *Candida albicans* growth, causing denture stomatitis (DS) in 50–70% of wearers. The types of denture materials influences the adhesion of *C. Albicans* and subsequently the development of DS. Heat-cured PMMA resins are polymerized under standardized conditions at high temperature & pressure; while CAD/CAM PMMA materials have different chemical structures, mechanical properties, & polymerization techniques. 3D printing is more efficient and cost effective but has weaker mechanical properties and higher fungal risk. Few attempts have also been made to modify CAD/CAM PMMA printed resin materials. Antifungal treatments often fail, prompting interest in antimicrobial additives like silver nanoparticles (SNPs), which offer antifungal effects without compromising strength. SNP use in CAD/CAM PMMA remains underexplored.

OBJECTIVE

To compare the effect of addition of cytocompatible concentration (1 $\mu\text{m}/\text{ml}$) of silver nanoparticles (SNP) on antifungal efficacy & flexural strength (FS) of CAD/CAM printed and heat-cured PMMA polymers.

METHODS

A total of 110 samples divided into following five groups were fabricated for the assessment of antimicrobial activity and flexural strength
Group A- Lucitone 199 heat-cured PMMA resin
Group B- Dentca printed resin
Group C- Ivotion base CAD/CAM milled resin
Group D- Lucitone 199 heat-cured PMMA resin modified with 1 $\mu\text{m}/\text{ml}$ SNP- Test
Group E-Dentca printed resin modified with 1 $\mu\text{m}/\text{ml}$ SNP -Test
Commercially available colloidal SNP 10 nm (Cytodiagnostics) were used in this study. Different materials used are presented in Table 1.

Table 1. Denture base materials and silver nanoparticles used

Material	Manufacturer	Fabrication Method
Denture Base II™ Shade: Light Pink	Dentca™	3D-printed resin
Ivotion Base Milled Denture Base™ (98.5 x 30mm) Shade: Pink	Ivoclar Vivadent™	Milled PMMA
Lucitone 199 Denture Base Resin™ Shade: Light	Dentsply Sirona™	Heat-polymerized resin
Silver nanoparticles (colloidal) 10nm	Cytodiagnostics™	Commercially available

Figure 2: Flexural Strength sample designing and testing using Instron

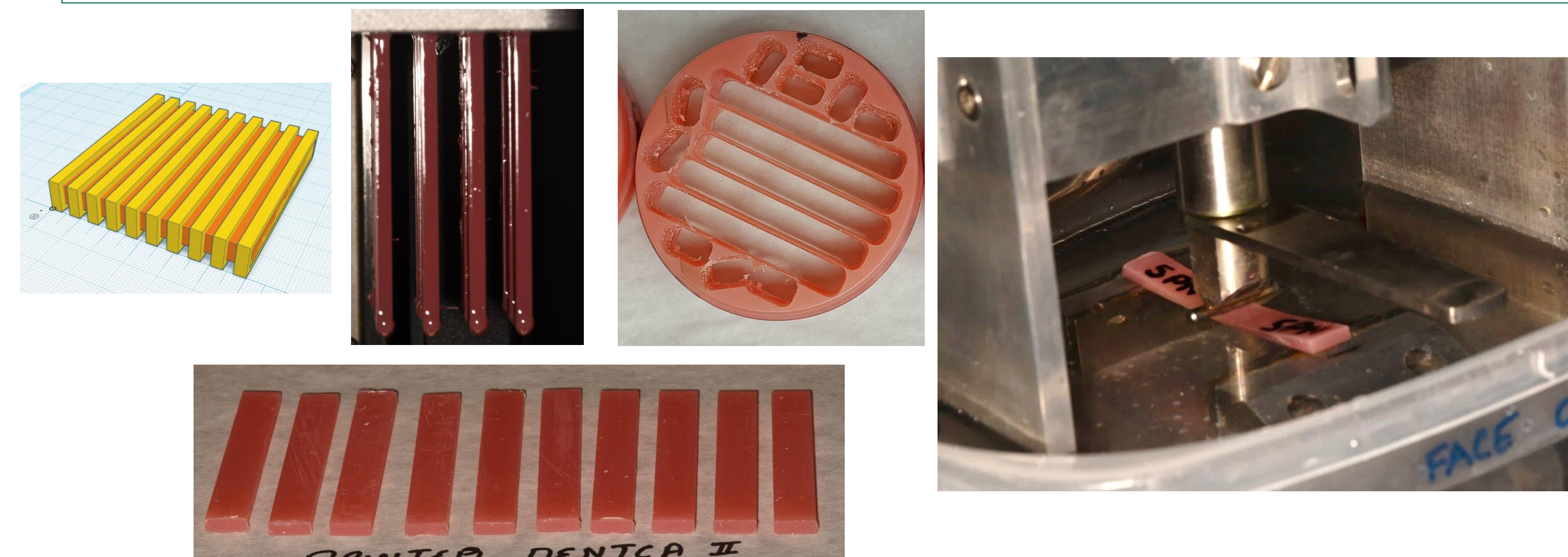


Figure 4: Pairwise comparison of groups with Bonferroni correction for OD600nm

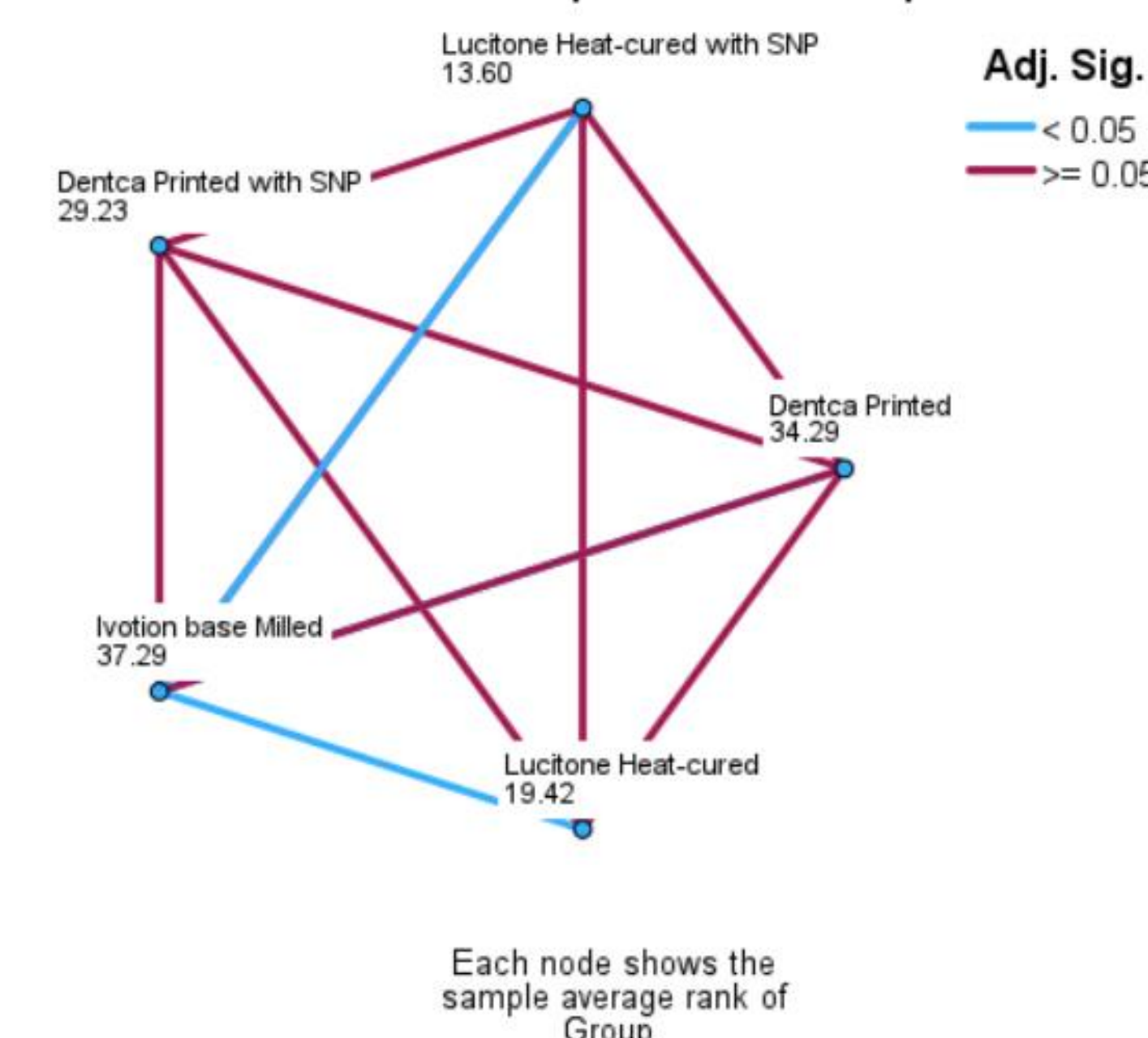


Figure 1: *C.albicans* adherence test set-up



Figure 3: Means and standard deviations of OD600 for denture base materials for tested groups

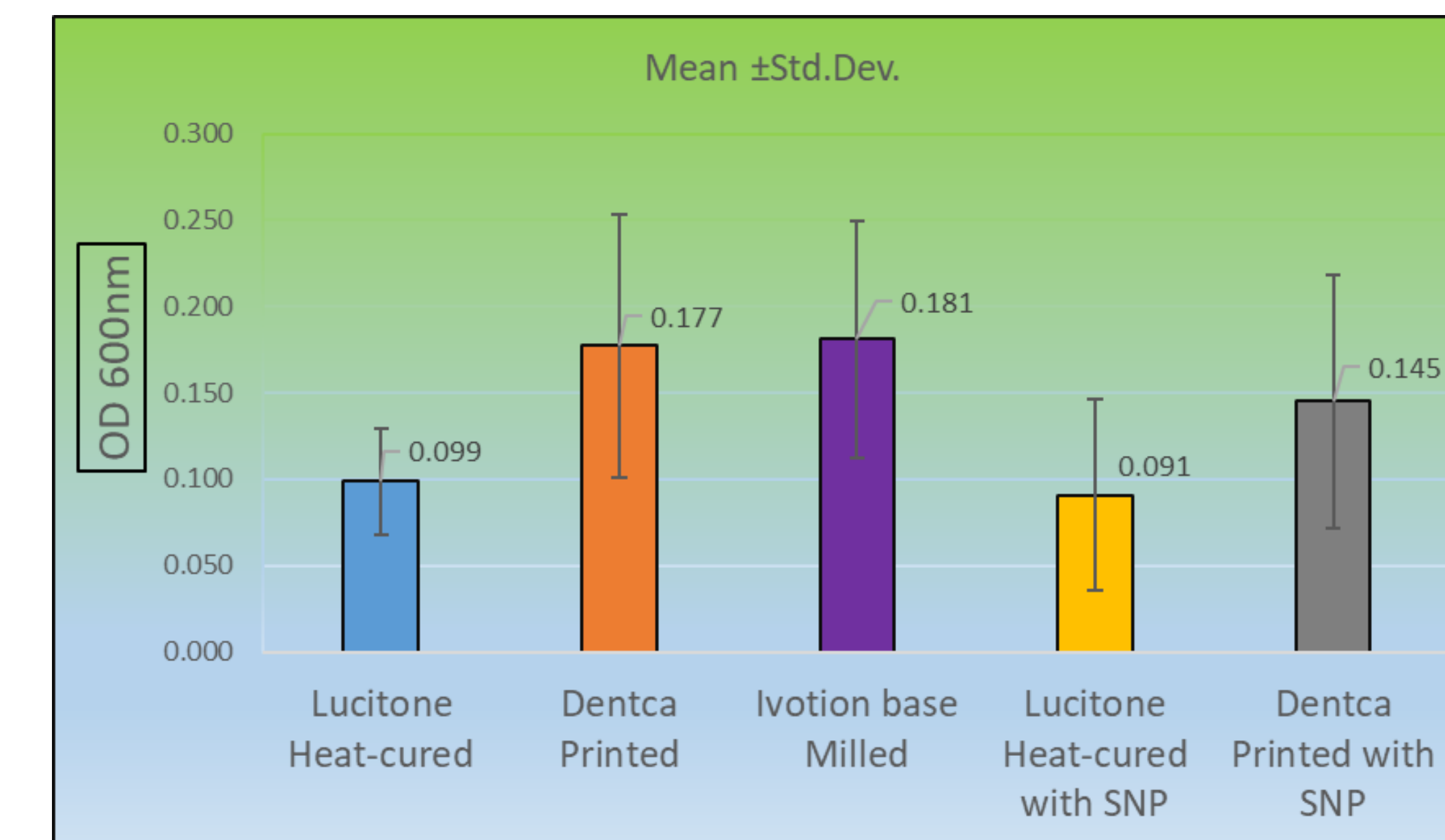
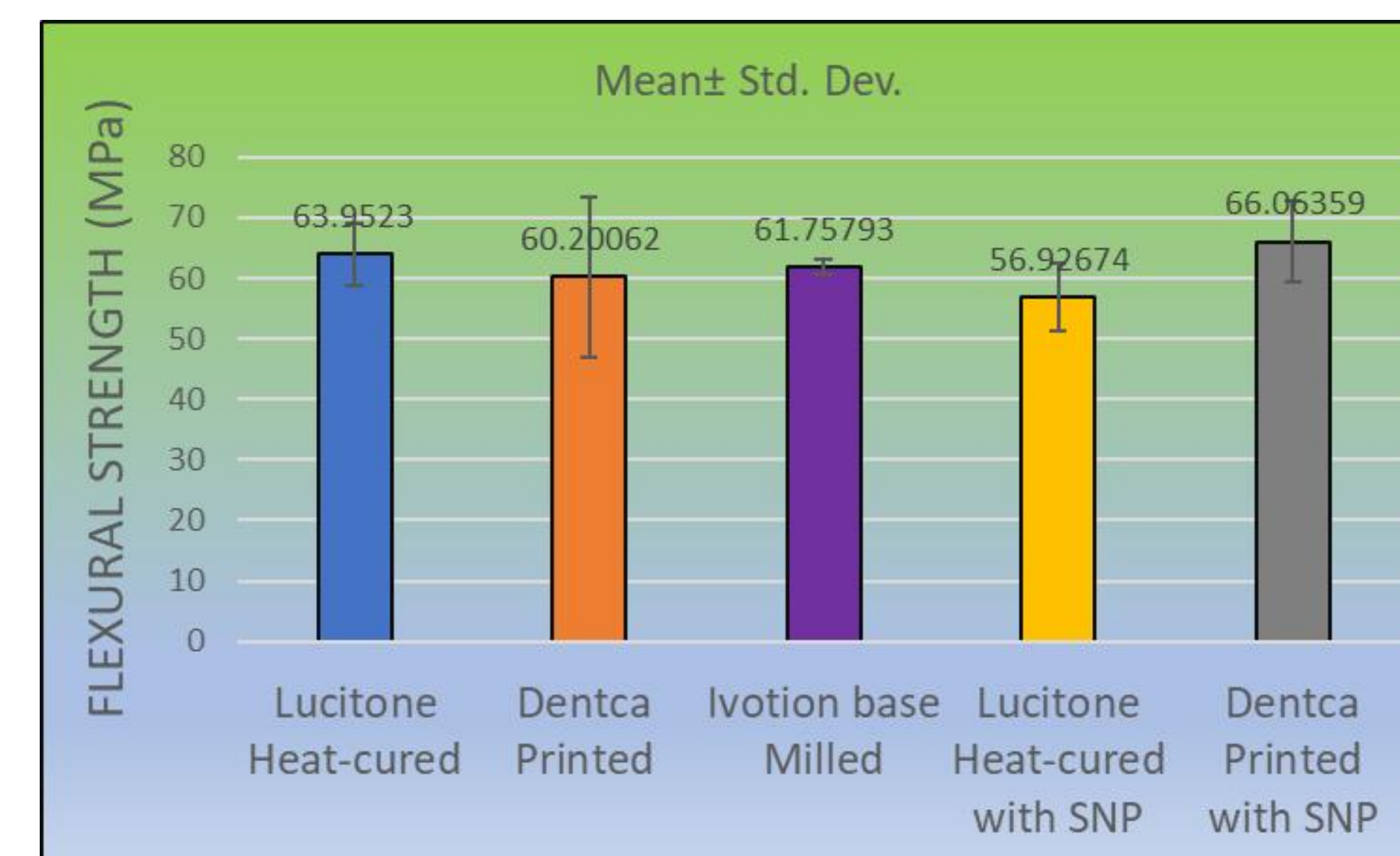


Figure 5: Means and standard deviations of flexural strength for tested groups



Optical density at 600nm as measured by a UV-VIS Spectrophotometer Mini 1240 (Fig. 1) was used to measure *C. albicans* adherence & a three-point bending test was performed to analyze the FS (Fig.2). Data analysis was conducted with SPSS v.29, using Kruskal-Wallis test with Bonferroni correction for *C. albicans* adherence and ANOVA for FS.

RESULTS

A statistically significant difference was observed for *C. albicans* adherence between different groups ($p=.001$)(Fig.3 and 4). SNP incorporation reduced *C. albicans* adherence to Lucitone 199 heat cured PMMA and Dentca II printed denture base resin. Lucitone heat cured and lucitone heat cured with SNP were significantly different than Ivotion milled base, that showed highest *C. albicans* adherence. However, no statistically significant difference was observed between different groups ($p>0.05$) for flexural strength . The mean flexural strength of Dentca printed material modified with SNP was highest and unmodified Dentca printed material was the lowest. The Lucitone 199 unmodified heat cured material had higher FS than Ivotion base milled material (Fig.5).

CONCLUSION

Different denture base resin materials have different flexural strength and *C. albicans* adherence. Addition of SNP to Dentca denture base II printed resin improves both its flexural strength and fungal resistance, making its characteristics close to Lucitone 199 heat cured PMMA resin.

REFERENCES FURTHER INFORMATION



pk23@uab.edu
hia71@pitt.edu
ccfu@uab.edu