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Title: Conceptual design of the beta prototype of an optical implant registration system

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Background: Accurate positioning of the artificial dentition in jaw reconstructions is important to benefit from the innovative advanced jaw reconstruction being carried out in Edmonton. For this, an accurate impression of the implant position as it is placed within the fibula is crucial. Currently the impression/registration of implant positions is carried out by using conventional dental impression materials which has its drawbacks. Initial attempt at developing a non-touch optical registration system of the implant resulted in the design of an alpha prototype. However these had certain shortcomings which were addressed in the beta prototype.

Objective: To improve the design of an optical implant registration system based on comprehensive redesign of the alpha prototype

Methods: 9 cameras (Raspberry Pi) were positioned in a rectangular frame of around 400 x 250 x 150 mm. Wireless cameras were used so as to do away with the plethora of wires that was an issue with the alpha version. A new design of the implant scan bodies were also developed along a new surface texture and colour – this was shaped as a dumbbell. The conceptual design aims to maintain the advantages of the alpha prototype while addressing its shortcomings.

Results: By using the beta prototype, the cameras can be positioned at an operating distance of 50-100cm lateral to the surgical site. Reduction in nominal accuracy is compensated by increasing the number of cameras, adding telescope lenses, and taking multiple shots of the scene – and the image capturing can be completed in less than a minute. The spherical flags are colored dark with laser finish to improve contrast and a double sphere design is adopted to provide the orientation of the implant. Accuracy testing of the implant registration with the beta prototype is ongoing.

Conclusions: The conceptual design of the beta prototype is attempting to address some of the shortcomings of the first (alpha) prototype used for optical implant registration system. Results obtained to date are encouraging and show that non-contact implant registration can be designed to meet constraints arising from computer vision and operating room conditions.