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**Introduction:** Aseptic loosening of the intramedullary stem remains one of the major causes of distal femoral massive bone tumour prosthesis (DFP) failure. The identifiable risk factors reported in the literature are age, bone resection length and time of follow-up¹. Concerns for successful long-term fixation have stimulated advancements in implant design and it has been reported that extracortical bone-bridging and osteointegration at the shoulder of the implant may reduce aseptic loosening by improving stress transfer within the cement mantle²-⁶. In this study, 22 patients with a DFP were pair matched according to age, resection length, follow-up time, and tumour diagnosis. Eleven patients had DFPs inserted with a circumferential HA coated ingrowth collar located at the shoulder of the implant and the other eleven patients had no collar present and instead a polished titanium alloy surface. All of these patients had the same prosthetic design. The aim of our study was to investigate and quantify extracortical bone growth and the development of radiolucent lines around the cemented interface. Our hypothesis was that a HA coated collar would increase osteointegration, reduce cortical bone loss at the bone-shoulder-implant junction and reduce the development of radiolucent lines around the cemented stem fixation.

**Methods:** Twenty-two patients were retrospectively pair matched. Inclusion criteria consisted of patients diagnosed with primary bone cancer and treated with a DFP between 1990 and 2000. Exclusion criteria consisted of patients with insufficient or irretrievable data and patients who received prostheses as revision of failed implants. Fourteen patients were female and 8 male and all were matched for age, length of bone resection, length of follow-up and tumour diagnosis. Hospital ethical permission was granted for this study. The mean age of patients at the time of surgery was 36.1 years (range, 16 - 66-years). Patients were followed-up at a mean of 7.1-years, (range, 2.3 - 11.7-years). The percentage of bone resected during surgery from each patient was calculated from AP radiographs and a mean of 37.0%, (range, 25 - 59%) of the length of the femur was resected. No significant differences in mean follow-up, age and resection length were found when the two experimental groups were compared. None of the implants were revised during the investigative period and each patient received a unilateral implant with 11 inserted into the right leg and 11 into the left. Both AP and ML radiographs obtained
throughout the follow-up period were analysed and osteointegration at the shaft of the implant quantified in the 4 aspects. Cortical bone loss at the bone-shoulder-implant junction was also measured and radiolucent line progression around the cemented stem was scored (Figure 1). The medial, lateral, anterior and posterior aspects adjacent to the intramedullary stem were each divided into 6 equi-distant zones. When a radiolucent line was observed at the cement-bone interface within a zone, a score of '1' was given. Therefore a maximal score of '12' could be obtained from each radiograph and a total score of '24', would indicate a prosthesis that was surrounded by radiolucent lines along the entire stem in both anterior-posterior and medial-lateral radiographs. Using data obtained from the most recent A/P and M/L radiographs, the Mann-Whitney U test was used for statistical comparison between HA Collar and Non-Collar groups where P values < 0.05 were considered significant. The Spearman Rank correlation coefficient was used to assess the dependence of the radiolucent line score and cortical bone loss. Mean values ± standard error of mean are presented.

**Results:** Extracortical bone formation occurred in both groups to the same extent over the follow-up time period investigated. However, comparison of the most recent radiographs showed nine out of 11 patients had osteointegrated HA Collars whereas only 1 patient in the Non-Collar group demonstrated osteointegration (p = > 0.05). Results showed a significant increase in cortical bone loss at the bone-shoulder-implant junction in the Non-Collar group (mean 1.07 ± 0.11 mm; range, 0.0 - 8.5mm) when compared with the HA Collar group (mean 0.39 ± 0.05; range, 0.0 - 2.0 mm) (p < 0.05). Cortical loss remained constant over the follow-up period in the HA Collar group, but appeared to gradually increase in the Non-Collar group over time, however no significant correlation was found. The radiolucent line score quantified around the cemented stem was significantly lower in the HA Collar group (mean 0.58 ± 0.13; range, 0 to 7) when compared with the Non-Collar group (mean 3.80 ± 0.40; range, 0 - 18) (p = 0.002) (Figure 2).

**Discussion:** Although similar amounts of extracortical bone growth was measured adjacent to the implant shaft in both patient groups, significantly increased osteointegration was observed within the grooved HA coated ingrowth collar located at the shoulder of the implant. Results also showed that implants with a HA collar had significantly fewer radiolucent lines adjacent to the intramedullary cemented stem and decreased cortical bone loss at the bone-shoulder-implant junction. These results suggest that osteointegration may prevent aseptic loosening of DFPs. This is possibly due to increased load transfer at the shoulder of the implant, resulting in less load transfer through the intramedullary cemented stem.

**Significance:** This study indicates the importance of osteointegration through bony bridging for bone tumour implants. HA collars can achieve this and their use results in reduced aseptic loosening.
Fig 1a: Radiolucent line separates implant and extracortical.

Fig 1b: Radiolucent lines at cement-bone interface. Extracortical bone integration within the grooves of the HA coated ingrowth collar.

Graph: Radiolucent line score over time (years) for HA Collar Group and Non-Collar Group.

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