Pin loosening and infection are the major post-operative complications in external fixation. Progressive mechanical deterioration of the bone-pin interface is an inevitable result of fixation with standard pins, regardless of type. This deterioration can lead to pin loosening, thereby contributing to infection of the pin tract. Thus, external fixation is a continual juxtaposition between the growing stability provided by callus maturation and the destabilizing effect of pin loosening.

Measurement Of Pin Loosening

The most precise method to quantify pin loosening is to measure the extraction torque of a pin and compare this measurement with the corresponding insertion torque. A pin extraction torque lower than the corresponding insertion torque is indicative of pin loosening.

In an animal study, the extraction torque of standard tapered pins decreased by 80% at twelve weeks when compared to the corresponding insertion torque. In a clinical study on tibial fractures, the extraction torque of Apex and Superfixation pins decreased by 83% and 93% respectively at twenty-three weeks, compared to the corresponding insertion torque.

Causes Of Pin Loosening And Infection

Bone-pin fixation is dependent on the integrity of the bone-pin interface. The primary causes of pin loosening and infection are thermal and mechanical damage to the bone during pin insertion and the subsequent fibrous tissue interposition at the bone-pin interface.

Solution

To improve bone-pin osteointegration and bone-pin fixation, OsteoTite® tapered pins coated with hydroxyapatite have been developed.
### RANDOMIZED STUDY

#### Knee Hemorrhages

Thirty-eight standard and thirty-eight OsteoTite pins were implanted in two paired groups of patients treated by hemiarthroplasty for osteoarthritis of the knee. Each patient received either standard or OsteoTite pins. To ensure high load at the bone-pin interface, a five-millimeter resection osteotomy was performed in the tibial mid-diaphysis. In six weeks, a crew showed significant pin loosening in the standard pins (A), while no loosening was observed, as demonstrated by the Checketts and Otterburn classification (B).

In both cortical and cancellous bone, extraction torque of the OsteoTite pins was higher than the standard pins (p<0.001). Furthermore, a deterioration of the bone-pin interface strength was observed with the standard pins (p<0.001), whereas an improvement of the bone-pin interface strength was observed with the OsteoTite pins (p<0.001). No correlation between extraction torque and the duration of fixation was found.

#### Femoral and Tibial External Fixation

Standard and OsteoTite pins were implanted in patients treated with femoral or tibial external fixators. Eighteen patients received seventy-one standard pins and twenty patients received eighty-six OsteoTite pins. Pin tract infection rate, measured according to the Checketts and Otterburn classification, was significantly lower with the OsteoTite pins than with standard pins.

When standard pins were removed from infected pin tracts, a lower extraction torque than those removed from uninfected pin tracts was observed (p<0.001). Even with the OsteoTite pins, there was no difference in extraction torque between the pins extracted from the infected or uninfected pin tracts. These results demonstrate that even in the presence of pin tract infection, the anchorage of OsteoTite pins is not compromised.

#### Pin extraction torque

Pin extraction torque was fourteen times higher in the OsteoTite pins (p<0.001) than in the standard pins, a significant deterioration of the bone-pin interface was observed, as demonstrated by an extraction torque seven times lower than the corresponding insertion torque (p<0.001). No deterioration was observed in the OsteoTite pins. The duration of fixation was found within the period studied.

#### Pin tract infection

When standard pins were removed from infected pin tracts, a lower extraction torque than those removed from uninfected pin tracts was observed (p<0.001). Even with the OsteoTite pins, there was no difference in extraction torque between the pins extracted from the infected or uninfected pin tracts. These results demonstrate that even in the presence of pin tract infection, the anchorage of OsteoTite pins is not compromised.

#### Conclusions

Regardless of study design, pin loosening was avoided and pin tract infection minimized with OsteoTite pins. The osteoconductive properties of hydroxyapatite enable bone remodeling, resulting in optimal pin osteointegration without fibrous tissue interposition. Additionally, strength and stability of the bone-pin interface are increased and pin tract infection rate reduced. With OsteoTite pins, pin exchange was maintained even in long duration treatment, in cancellous bone, in osteoarthritic bone, and in the presence of infection of the bone-pin tract. OsteoTite pins represent a tremendous advance in the reliability of external fixation.

### References