The biological and physiological effects of intramedullary reaming
Introduction

• the current knowledge on the effects of medullary reaming of long bone fractures
The kinetics of the intramedullary blood supply

The arterial system

There are three different vascular trees within the arterial system:

- the nutrient artery and its branches
- the perforating metaphyseal and epiphyseal arteries and
- the periosteal vessels
The kinetics of the intramedullary blood supply

• The process of intramedullary reaming largely destroys the intramedullary arterial system.

• A study by Schemitsch et al has clearly demonstrated that reaming alters bone perfusion, but that this appears to resolve by three months.
Regulation of the intramedullary blood flow

• Passive changes of intramedullary blood flow

Several independent parameters can influence the medullary blood flow

1) changes in inflow due to variation in the systemic blood pressure and muscle blood flow
2) changes in outflow due to venous obstruction
3) pressure changes induced by respiration
Regulation of the intramedullary blood flow
Regulation of the intramedullary blood flow

Active changes of intramedullary blood flow

- The regulation of blood flow is also influenced by active, neural and biochemical mechanisms.
- Under physiological conditions there is centripetal blood flow.
- With a rise in intramedullary pressure, reversal of the direction of flow may occur.
Intramedullary pressure changes and intravasation of bone marrow

- In order to achieve intravasation of bone marrow or fat into the vascular system, the intramedullary pressure has to be surpassed.

1) The highest pressure values are achieved during the initial reaming

2) the maximum pressure increase is achieved after the reamer has entered the main distal fragment since there is no further reduction of pressure by leakage from the fracture line

3) in the course of femoral nailing the reaming procedure produces an increase in intramedullary pressure, but insertion of the nail does not appear to cause a further rise
Generation of heat

- During reaming rises in temperature of more than 50°C have been reported.
- The critical temperature for thermal injury of bone is considered to be 56°C which is the level at which denaturation of alkaline phosphatase occurs, but extensive cortical necrosis has been reported at temperatures higher than 70°C.
Autografting by debris from intramedullary nailing

- Reaming mobilises cancellous bone inside the medullary canal
- Exchange reamed nailing is a standard procedure in patients with nonunion after fractures.
- There appears to be stimulation of revascularisation by the breaking-up of intramedullary scar tissue
“Exchange nailing is an excellent choice for aseptic nonunions of noncomminuted diaphyseal tibial fractures, with union rates reported to range from 76% to 96%”.

Brinker and O’Connor
Effect on the vitality of cell populations and release of growth factors

• Some authors have shown that the reaming debris is a source of multipotent stem cells which can grow and proliferate in vitro

• This has prompted interest in the use of these stem cells in cell and bone replacement therapy
• Thank you