THE INFLUENCE OF AUTO-GRAFTING ON FRACTURE HEALING AFTER RIA REAMED AND CONVENTIONALLY REAMED NAILING

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ABSTRACT INTRODUCTION:
Earlier studies have shown that bone debris, gathered after reamed intramedullary nailing, contains vital bone chips and vital tissue from which bone cells grow. It has been shown that these bone cells grow at the same rate as bone cells from cancellous bone graft from the iliac crest. A significant effect on fracture healing by the use of bone graft was shown by Frolke. These results confirmed the clinical hypothesis of improved fracture healing after implantation of bone graft. The newly developed “Reamer-Irrigator-Aspirator” (RIA) for intramedullary reaming has the possibility of obtaining biologically active reaming debris, which are produced during reaming. This study was designed to investigate the bio-mechanical quality of fracture healing and the differences in callus formation after the implantation of reaming debris into the fracture gap.

METHODS:
24 healthy adult female swiss mountain sheep with an average age of 3.5 years (Tierversuchsbewilligung GR 11/2002) that had average tibial medullary canal diameters of 8-9mm (lateral x-ray) were gathered for standardised reaming. The medullary canals were reamed to 11mm. In groups A and B the sheep were reamed using the RIA System (Synthes USA) while in group C the Synream-Reamer System (Synthes USA) was used.

The tibiae were osteotomized and stabilized with an interlocked im nail (UHN, ø 9.5mm) keeping the osteotomy gap at a distance of 8mm. Soft tissue was removed at a distance of 0.5cm proximal and distal of the osteotomy. A trap for the collection of bone debris was connected to the RIA-System. The groups were treated with the methods described in Tab. 1.

<table>
<thead>
<tr>
<th>Group</th>
<th>RIA</th>
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<tr>
<td>A</td>
<td>RIA &amp; Bone debris</td>
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<tr>
<td>B</td>
<td>Synream</td>
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<td>C</td>
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After stabilisation the bone debris were implanted into the 8mm gap. Standardized ap and lateral x-rays were obtained direct post-operative and after 2, 4 and 6 weeks. Up till 4 weeks after surgery the sheep were kept in suspension. After 4 weeks post-surgery the sheep were kept in single boxes. The sheep were sacrificed after 6 weeks observation time. After implant removal the bio-mechanical quality of the operated and contralateral tibiae was tested by the MTX Bionix 858 (MTS Systems Corp., Minneapolis, MN) in torsion (medial cortex under stress).

The callus area was measured with the softwareprogramm KS 400, Zeiss, Germany. A statistical evaluation of the results was then preformed using the Kruskal-Wallis Test and the Kolmogorov-Smirnov Test.

RESULTS:
The mean value of torsion found in Group A was 6.94 Nm ± 4.77 Nm, while in Group B the mean value of torsion was 14.09 Nm ± 4.74 Nm. In Group C the mean value of torsion was found to be 5.21 Nm ± 2.64 Nm. The results of the biomechanical testing showed that there were statistically significant differences between groups A and B (p = 0.029) and Groups B and C (p = 0.001). In contrast to these findings, the results for Groups A and C were of no statistical significance.

GROUP A showed an increase of 1708 mm² in the measured callus area in the combined ap and lateral view. Group b showed 3579 mm² more callus formation and group c increased with 1406 mm². The increase of callus formation from week 4 to week 6 showed a significant difference between groups b and c (p<0.01), as well as between groups b and c (p<0.01). There was no significant difference between group c and a.

DISCUSSION:
In this study it was shown that through the implantation of acquired bone particles in the area of bone defect, the quality of bone healing is improved in comparison to the healing achieved without implantation. Although the importance of the bone debris for the healing process has already been investigated, this study further showed that the affective harvesting of biologically active bone debris with the Reamer Irrigator Aspirator System (Synthes©) is an uncomplicated method yielding a relatively high success rate. Re-grafting of obtained bone chips causes a significant increase in the callus formation during osteotomy healing between 4 and 6 weeks. No differences in osteotomy healing were found between the tested reaming systems RIA and Synream.

Reaming produces debris in the intermedullary cavity which can be harvested and grafted. Upon consideration of the results from this study, which are better biomechanical performance and increased callus formation for the RIA-reaming group with auto-grafting, the utilization of this system, which makes the recovery of bone particles possible, is recommended.

REFERENCES

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