Summary:

The doctoral thesis was conducted as an implementation doctorate to develop and introduce the production and sale of non-locked orthopaedic intramedullary nails. As a result of cooperation with the medical community through many years of activity covering the area of engineering materials used for implants and the production of the implants, the problem of lack of appropriate steel with mechanical properties adapted to the requirements for implants dedicated to patients in the growth phase was defined. Hence, the main goal set in the thesis was to develop a new type of implantation steel and a method of its plastic processing, leading to an increase in the range of plastic deformations. The scientific goal was to link the parameters of cold forming of implant steel with changes in structure and their impact on the mechanical properties that meet the requirements of the standards and regulations. Based on the results of scientific research, an implementation goal was defined - the production of non-locking orthopaedic intramedullary nails used to connect bone fragments and introduce them for sale on the domestic and foreign markets.

The result of the scientific research work was the design of the appropriate chemical composition of implantation steel and the production of a melt on an industrial scale, from which the wire rod was made with parameters consistent with medical standards. The new steel was designated as the Bioval 5832 – 1 (316LVM). The stages of plastic processing were designed and implemented, leading from the hot rolling of wire rods through cold plastic processing of wires and rods to the production of intramedullary nails. The research carried out at individual stages made it possible to connect the relationship between the parameters of steel production and processing processes with the physicochemical and mechanical properties of the final product. The results became the basis for developing a technology for producing a pilot batch of wires, rods and non-locking intramedullary Kirchenr and Steinmann's nails on an industrial scale. In their final form, the nails were characterized by mechanical properties, maintaining a high reserve of plasticity while meeting the requirements of applicable standards. They were not toxic to living organisms and did not show unfavourable features typical of magnetic phases.

Finally, the developed orthopaedic nails were implemented into production in the Valbruna Group in cooperation with BHH Mikeromed and BHH Mikrohuta. The SWOT analysis showed the possibility of using an aggressive sales strategy. The business result of the PhD thesis was the introduction of non-locking intramedullary nails into production and their sale in domestic and foreign markets.