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Original article

Experimental trial on surgical treatment for transverse fractures of the proximal phalanx: technique using intramedullary conical compression screw versus lateral compression plate☆

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ARTICLE INFO

Article history:
Received 17 June 2014
Accepted 25 August 2014
Available online 1 August 2015

Keywords:
Bone fixation
Internal fixation of fractures
Hand injuries
Finger injuries

ABSTRACT

Objective: To compare the mechanical parameters between two methods for stabilization through compression: 1.5 mm axial compression plate versus conical compression screw used as an intramedullary tutor.

Methods: Polyurethane models (Sawbone®) that simulated transverse fractures of the proximal phalanx were used. The models were divided into three groups: lateral plate, conical screw and no implant.

Results: Greater force was needed to result in fatigue in the synthesis using an intramedullary plate. Thus, this model was proven to be mechanically superior to the model with the lateral plate.

Conclusion: Stabilization using the Acutrak® screw for treating fractures in the model used in this trial presents mechanical results that are statistically significantly superior to those from the axial compression technique using the lateral plate (Aptus Hand®).

Ensaio experimental para tratamento cirúrgico das fraturas transversas da falange proximal – Técnica com parafuso intramedular cônico de compressão versus placa de compressão lateral

Palavras-chave:
Fixação óssea
Fixação interna de fraturas

RESUMO

Objetivo: Comparar os parâmetros mecânicos entre dois métodos de estabilização por compressão: placa de compressão axial de 1,5 mm com o parafuso cônico de compressão usado como tutor intramedular.

☆ Work developed in the Laboratório de Ensaios Mecânicos e Metalográficos (LEMM), Jaú, SP, Brazil.

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http://dx.doi.org/10.1016/j.rboe.2014.12.009

Traumatismos da mão
Traumatismos dos dedos

Métodos: Foram usados modelos de poliuretano (Sawbone®) que simulam a fratura da falange proximal transversa, divididos em três grupos (placa lateral, parafuso cônico, sem implante).
Resultados: Há necessidade de uma maior força para resultar na fadiga da síntese com parafuso intramedular. Comprova-se, assim, a supremacia mecânica desse sobre o modelo com a placa lateral.
Conclusão: A estabilização com o parafuso Acutrak®, no tratamento das fraturas no modelo adotado neste ensaio, apresenta resultados mecânicos superiores e estatisticamente significativos em comparação com a técnica de compressão axial com o uso da placa lateral (Aptus Hand ®).

Introduction

Fracture of the phalanges are frequent injuries and account for 6% of all fractures.[1,2] The proximal phalanx is fractured more frequently than the middle or distal phalanges.[3,4]

Indications for surgical treatment for these fractures need to take into consideration the type of fracture line, the displacement between the fragment and the difficulty in maintaining closed reduction of the fracture.[3] The aim of surgical treatment is to restore the anatomy and function of the affected finger.[4,5]

The techniques that have been described range from seeking relative stability to the principle of absolute stability. A combination of methods is sometimes necessary,[6] and this depends on the nature of the fracture line, the availability of implants and the surgeon's preference.

Among the surgical complications, the following can be highlighted: joint stiffness, adherence and/or tearing of the extensor tendon,[1] functional loss of the finger[2] or, additionally, skewed consolidation, pseudarthrosis and osteomyelitis.[5–7]

These complications are often caused by poor knowledge of the biomechanics of this organ; an unfounded belief that all fractures of the hand can be resolved through conservative treatment; or poor cooperation from the patient.[8]

In seeking to minimize these complications, Mantovanni et al.[9] described lateral positioning of the plate in which the extensor tendon was left untouched so as to avoid tendon adherence and joint stiffness. Another option would be to use the principle of an intramedullary internal tutor,[10,11] such as a conical compression screw (Acutrak®), to be placed percutaneously. We describe this novel technique in the present study.

The objective of this study was to compare the mechanical parameters of two methods of stabilization through compression: a 1.5 mm axial compression plate versus a conical compression screw used as an intramedullary tutor. Both of these methods were used on fractures of the diaphysis of the proximal phalanx that followed a transverse line.

Methods

This study was conducted in the Mechanical and Metallographic Testing Laboratory (LEMM), in the city of Jaú, state of São Paulo, Brazil, in May 2012. This laboratory has been certified by INMETRO.

Fig. 1 – Group I model before the mechanical test.

Fig. 2 – Group II model before the mechanical test.

Fifteen polyurethane models simulating the proximal phalanx (Sawbone®), of dimensions 10 mm × 8 mm × 60 mm and density 40 pounds per cubic foot (lb/ft^3) were used. Simple transverse fractures with a single line at an inclination of less than 30° were made.[12]

These models were divided into three groups: five models for each group with synthesis material (groups I and II); and three models for a group without synthesis material (group III).

Group I – with a 1.5 mm compression plate and four cortical screws (Aptus Hand®), placed in the lateral region of the model (Fig. 1).
Group II – one conical compression screw (Acutrak®) of standard type, positioned intramedullarily (Fig. 2).
Group III – models of the phalanx without an implant and without a fracture (Fig. 3).

Placement technique for the lateral plate in the polyurethane model (Fig. 1):

Placement of 1.5 mm plate positioned laterally in the model and, after reduction, placement of four bicortical screws (two

Fig. 3 – Group III model before the mechanical test.