Kinematic Analysis for Evaluation of Therapeutics Osteo-Articular Reconstruction in Dog

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Abstract. In this study was assessed osteochondritis dissecans healing process in dogs using kinematic analysis performed at 95 days after intra-articular injection of a chondroblasts suspension. The results of kinematic analysis were compared with those obtained in healthy animals and with patterns obtained in day 14 after induction humeral head osteochondritis dissecans by surgery.

Key words: kinematic, videography, dog, osteochondritis

INTRODUCTION

Among the few studies about detection of kinematic pattern changes of thoracic limb joints there is a study reported by Bockstahler et al. (2008) regarding dogs with subclinical unilateral or bilateral tendinopathies of supraspinatus, infraspinatus and biceps brachii muscles. Other important application of kinematic analysis is assessment of different surgical techniques used for cruciate ligament rupture treatment (Lee et al., 2007; Adriany and Matis, 2002).

Bollinger et al. (2002) were used kinematic analysis combined with force plates in purpose to assess response of dogs diagnosed with hip dysplasia at symptomatic osteoarthritis treatment by acupuncture.

MATERIAL AND METHODS

Biologic material consisted in 16 common breed dogs in which osteochondritis dissecans (OCD) lesions were surgically induced on humeral head.

At 30 days after surgery, humeral head defects of the experimental group individuals were treated only by intra-articular injection of 1 cm³ chondroblasts suspension derived from culturing the mesenchymal stem cells.

Some of the humeral head defects of control group individuals were treated with collagen/collagen-hydroxyapatite scaffolds without cells and some of them were left untreated. The scaffolds were fixed with polyethylene screws or polyglycolic acid rods.

Subjects’ assessment was made in day 95 after injection with Ariel APAS system at Kinematic Analysis Laboratory, Polytechnic University Timisoara. This system is base on video recording with the passive markers fixed on the reference points of the investigated subject, as follows: dorsal aspect of the scapular spine, greater humeral tuberculum, humeral lateral epicondyle, ulnar styloid process, and latero-distal aspect of the 5th metacarpal bone.
RESULTS AND DISCUSSIONS

The results of kinematic analysis were compared with those obtained in healthy animals and with the patterns obtained in day 14 after induction OCD of the humeral head by surgery (Dascălu et al., 2008).

Scapulohumeral joint

In experimental group individuals (Fig. 1) at 95 days after injection, the joint with OCD exhibits a decreased extension during suspension phase, followed by a maximal extension peak with slightly lower amplitude than in normal joint. These alterations were associated on angular velocity curve with a quicker extension in suspension phase.

Fig.1 Shoulder joint (experimental group)

In the control group individuals (Fig. 2) was registered decrease of the flexion in the end of stance and decrease of the extension during suspension phase, with a higher maximal extension peak. Comparing angular velocity curve of healthy joint with that obtained at 95 days post-implantation for the same joint, it was registered a slower flexion in the end of stance and a quicker extension during suspension phase.

Fig.2 Shoulder joint (control group)
**Elbow joint**

*Experimental group* (Fig. 3). Comparing to the data obtained at 14 days after OCD induction (Dascălu *et al.*, 2008), *elbow joint of the leg with OCD* exhibits a gentle increase of the flexion in early stance phase, similar to the motion registered in healthy joint. Also, comparing to healthy joint, extension during the stance phase remains increased.

Comparing to the kinematic pattern registered at 14 days after OCD induction (Dascălu *et al.*, 2008), it was observed a slightly decrease of the flexion during suspension, motion that attains the value registered in healthy joint.

As regards velocity, in comparison with curve obtained at 14 days after OCD induction (Dascălu *et al.*, 2008), the flexion was quicker, returning at the value observed in healthy joint. Flexion initiated in the end of stance phase is similar to that observed in healthy joint and slower comparing to values registered at 14 days after OCD induction. Extension was quicker during suspension than in healthy joint.
Additionally to the data registered in the experimental group at 95 days post-surgery, in the control group individuals (Fig. 4), elbow joint of the leg with OCD exhibits a decrease of the flexion in the end of stance phase. As regards velocity, in this group was registered only the quicker extension during stance phase.

**Carpal joint**

*Experimental group* (Fig. 5).

In comparison with healthy joint, antebrachiocarpal joint of the leg with humeral head OCD showed only slightly decrease of the flexion during suspension, followed by a lower maximal flexion peak. Comparing to the motion observed at 14 days after OCD induction (Dascălu et al., 2008), at 95 days after surgery it was registered increase of the flexion in the end of stance phase, similar to the healthy joint pattern.

![Fig. 5 Carpal joint (experimental group)](image1)

![Fig. 6 Carpal joint (control group)](image2)
In control group individuals, kinematic pattern of antebrachiocarpal joint of the leg with humeral head OCD was characterized by persistence of the alteration detected at 14 days post-surgery (Dascălu et al., 2008) – increase of the extension during stance, decrease of the flexion in the end of this phase (a lower maximal flexion peak), and decrease of the extension in the end of suspension phase, which attains the value registered in healthy joint.

In comparison with velocity curve obtained at 14 days after OCD induction (Dascălu et al., 2008), flexion becomes much slower in the end of stance phase.

Partial healing of the osteochondral defects after treatment of the experimental individuals, detected also by other imagistic techniques (CT, arthroscopy), is associated with persistence of some subtle alteration in the kinematic pattern of the thoracic limb joints.

Preservation of the osteocartilaginous defects size in most of the cases and development of degenerative lesions in some individuals is accentuated also by persistence or even exacerbation of kinematic alteration observed at 14 days after OCD induction by kinematic analysis.

CONCLUSIONS

Favorable evolution of articular cartilage healing in the experimental group individuals is confirmed by kinematic analysis that showed only little deviation to the normal kinematic pattern of healthy joints.

In control group individuals, joint movements changed during the time, being characterized by maintaining or even emphasizing of the specific kinematic pattern. That suggests the persistence of joint cartilage damages.

Having capacity to detect subtle changes in joints motion, with dynamic monitoring of these, kinematic analysis allows assessment of joint movement re-establishment after various surgical or using drugs for treatment.

REFERENCES


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